AIR CONDITIONING HEATING AND VENTILATING

JULY 1959

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

IN THIS ISSUE

New Tables on Water Flow in Schedule 40 Pipe 59

Discomfort Index Data Sheet 75

Refrigerant and Compressor Piping Hook-Ups 75

Application and Sizing of Pressure Reducing Valves . 85

Layouts for Safeguarding Water Supply for Hospitals 56

Fluid Drives for House Pumps Eliminate Water Tanks 45

Design of a Solar Cooler .. 50

Solar Water Heating 53

New Literature 89

New Equipment 92

Ad-Digest 147

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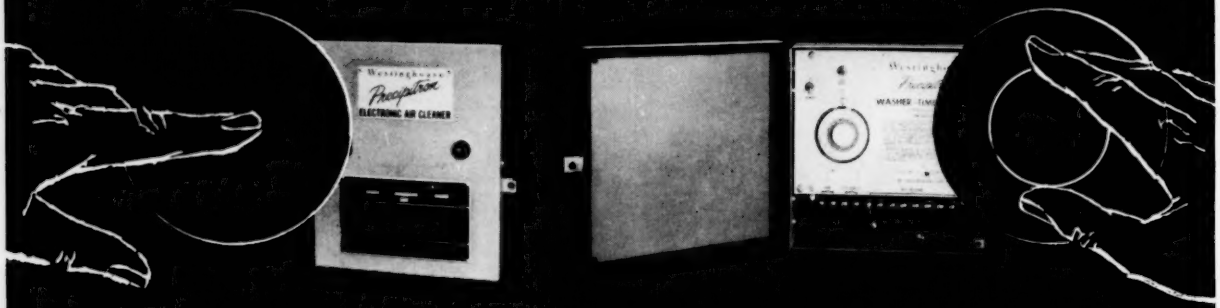

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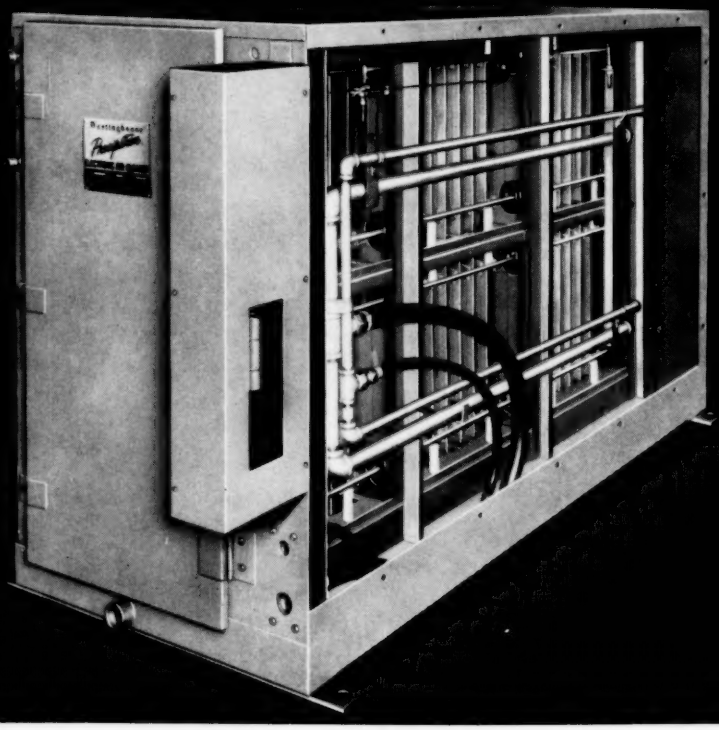

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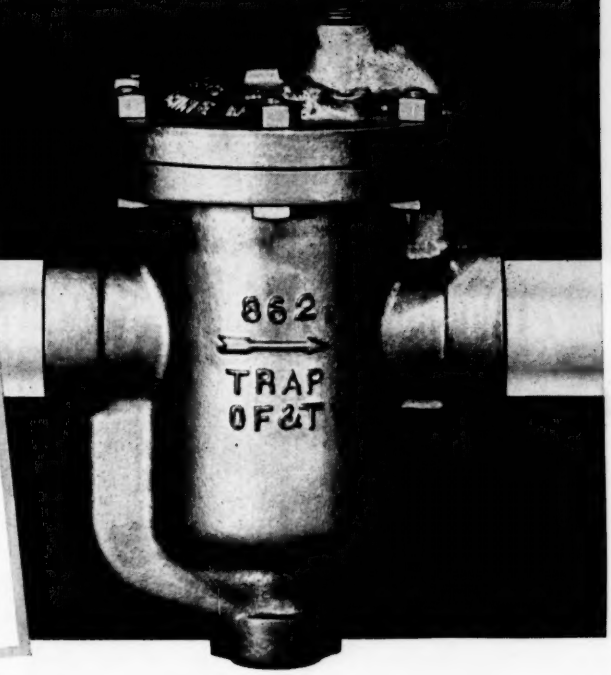

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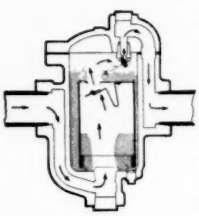
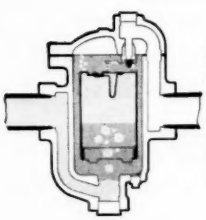


When steam is turned on, it pushes air through the wide open thermic vent and trap discharge valve at full differential pressure between supply and return lines. Condensate formed by incoming steam goes right through.



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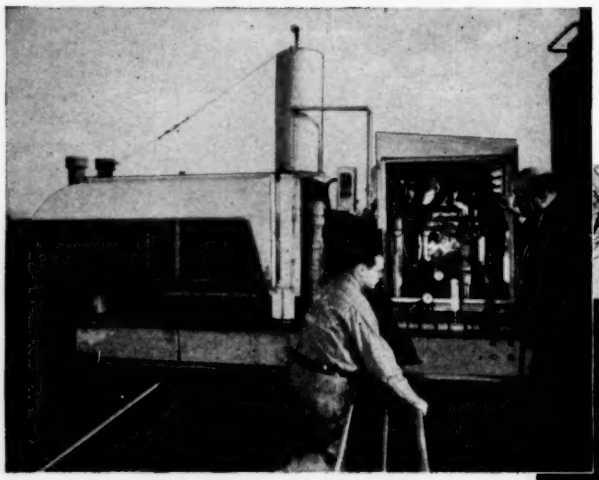
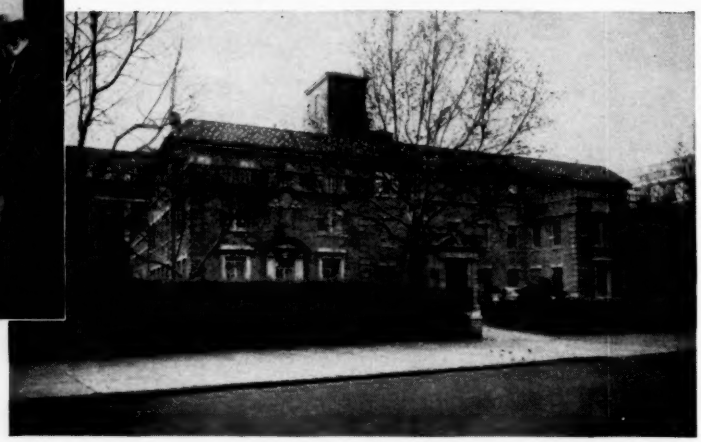


MOTHER CABRINI MEMORIAL HOSPITAL
New York City, New York
Supervisor: Mother Charitas, MSC



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AIR CONDITIONING HEATING AND VENTILATING

Volume 56, Number 7 July, 1959

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PLUMBING

Fluid Drives for House Pumps 45
New method offers advantages in control of service water systems. C. L. Arnold

SOLAR ENERGY SYMPOSIUM

Solar Space Cooling 50
Design considerations and test results. ..... Chung, Löf, and Duffie

Solar Water Heating 53
Present practices and new directions. ..... E. A. Farber

PLUMBING

Safeguarding Water Supplies for Hospitals 56
Procedures to follow when designing. ..... G. R. Jerus

AIR CONDITIONING

When Does Industrial Air Conditioning Start Paying a Profit? 58
Curves show efficiency increase required to pay for air conditioning.

PIPING

Reference Section—Pipe Friction Tables 59
Friction loss for 60-, 180-, and 300-deg water. ..... R. L. Koral

PSYCHROMETRICS

Data Sheet—The Discomfort Index (Continued) 75
New table gives DI values at a glance.

PIPING

Detail Sheet—Refrigeration Piping Hookups 77
Circuits for multiple condensers.

STEAM

More Efficient Steam Operation 79
Abstracts of NDHA convention papers.

COMBUSTION

Overfire Jets Help Smoke Abatement 83
Four key factors evaluated in study.

DEPARTMENTS

High Spots in the News 4
Washington Overtones—L. Overman 6
News of the Month 10
Scientific Frontiers 16
Picture Paragraphs 84
Piping and Plumbing—L. Blendermann 85
New Literature 89
New Equipment and Materials 92
Degree-Days for May, 1959 118
Briefly Stated News Items . 122
Book Reviews 134
Canadian Degree-Days for May, 1959 136
What Readers Say 136
Coming Events 137
Index to Advertisers 143
Ad-Digest 147

HIGH SPOTS

Dr. Detlev W. Bronk, president of the National Academy of Sciences—National Research Council, Washington, announced appointment of six delegates to the 10th International Congress of the International Institute of Refrigeration meeting in Copenhagen, Denmark, from August 19 to 26 of this year. The delegates, all members of the U.S. National Committee for the International Institute of Refrigeration, are: Dr. R. C. Jordan, head, Department of Mechanical Engineering, University of Minnesota; J. E. Dube, president, Alco Valve Company; W. T. Pentzer, chief, Biological Sciences Branch, Marketing Research Div., Agricultural Marketing Service, U.S. Department of Agriculture; Dr. F. G. Brickwedde, dean, College of Chemistry and Physics, Pennsylvania State University; Dr. C. F. Kayan, executive officer, Mechanical Engineering Department, Columbia University; and B. H. Jennings, director, Research Laboratory, American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Heat pump usage is increasing in California, according to Living for Young Homemakers magazine. Operating studies now being conducted by Southern California Edison Company show that it costs from ½ to ¾ cent per sq ft of living area per month there to warm and cool an average house with an electric heat pump.

Next to the national event, the 3rd Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference will be the largest display of its kind in 1960, announces William P. Tennity, President, Western Air Conditioning Industries Association. The outstanding display, with exhibits and speakers from all parts of this country, will be held April 27-30 in Shrine Exposition Hall, Los Angeles. Mr. Tennity based his forecast on tremendous growth of air conditioning and its associated activities in the thirteen Western States, including Alaska and Hawaii. **He cited recent statistics which point out that more industrial, government and commercial construction—including motels, office structures and residential units—will be realized in these thirteen states than in any other combined 26 states of this country.**

The integrated air conditioning system of Rockefeller Center, New York City, already the world's largest, will be expanded with the addition of a 1,500-ton-capacity centrifugal refrigeration machine. The big unit, manufactured by Carrier Corporation, will swell the Center's system capacity to 16,677 tons.

To make practical use of the Weather Bureau's Discomfort Index, a person might add from three to five points of discomfort for indoor conditions, according to Herbert T. Gilkey, technical director of National Warm Air Heating and Air Conditioning Association, Cleveland, Ohio. The reasons: While indoor temperature (of non-air conditioned space) may be lower than outdoors, humidity is the same and air movement usually nil. Psychological factors enter, too. People are less aware of discomfort when outdoors, engaged in recreation, for instance.

An engineering couple was chosen by the National Society of Professional Engineers from 2,000 applicants to make a month-long Spring tour of South American nations. Their mission: **to determine the attitudes and problems facing American engineers who are sent to work overseas.** Such personnel do not always acquit themselves well as unofficial representatives of the United States and of the corporations which employ them, the Society believes. The Society wants to know what are the problems and what can be done to solve them. The couple are Rodney D. Chipp, director of engineering of I.T.T. Communication Systems, and his wife, Dr. Beatrice A. Hicks, president of Newark Controls Co., Bloomfield, N.J. Both plan to read "The Ugly American" before embarking. The book sketches blunders made by uninformed Americans in Southeast Asia.

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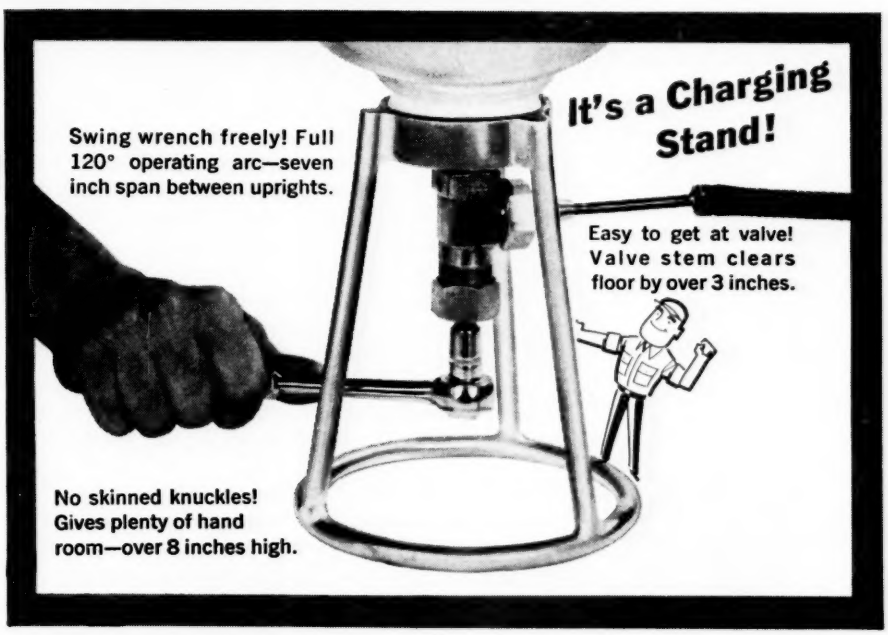
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WASHINGTON OVERTONES

by LORING F. OVERMAN

● Possibly air conditioning itself is the principal overtone in mid-summer Washington.

No longer does Congress rush to adjourn with the first hint of warm weather. Instead, the air-conditioned chambers and offices on Capitol Hill provide a cool backdrop for heated legislative oratory.

And no longer do tens of thousands of Government employees close their desks and head for home (or the pools or beaches) when the thermometer reaches 90 plus. Instead, air-conditioned offices are the rule rather than the exception, and work places are now comfortable and inviting.

● Even "must" legislation has experienced some difficulty in making the deadlines. Examples:

Extension of Korean War excise taxes and the 52% corporate income tax rate. Deadline June 30 would permit rate reduction to 47% for corporations, and reduce excises to pre-Korea rates on liquor, cigarettes, autos and auto parts.

Increase in statutory debt limit. Increase to $295-billion considered by Administration as necessary to support loan programs.

Extension of Renegotiation Act for two years—to permit reclaiming of excess profits on defense contracts.

● Another measure—omnibus housing—appeared to be delayed by political heat that overcame air-conditioned coolness.

Passed in record time by the Senate shortly after convening last January, the housing bill (S-57), was bottled up in the House Rules Committee for weeks. Passed by the House on May 21, a Senate-House conference committee held the measure for another three weeks before beginning hearings.

With funds for Federal Housing Administration at stake, some Washington observers see in the delay a political move to force Presidential approval as an emergency funding measure. The Administration has indicated that the measure will be vetoed unless certain budget-busting features are eliminated.

● Extra sales for room air-conditioners of more than one-horsepower capacity were seen as an overtone of pending tax actions which may involve those sizes.

Since 1947 the Treasury Department has maintained that an excise tax provision levying a 10% tax on self-contained air conditioners has applied only to units below one horsepower. The air conditioning industry has been urging the removal of the smaller machines from the tax requirement.

With extension of the excise rates a foregone conclusion, revenue hunters have reversed the field and come up with the idea that the above-one-ton units might as well be taxed too. Washington observers consider it unlikely that such action will be taken before autumn, if at all.

Meanwhile, there are indications that some dealers are hurrying sales by stressing the saving of a "10% tax" if, when, and as one may be levied.

● Whatever the cause, sales of room air conditioners are expected to total between 1,600,000 and 1,750,000 units in 1959—a gain of from 18% to 39% over last year.

Room units customarily account for about 20% of the total market. In 1958, retail sales of room conditioners reached approximately $480,000,000 out of an industry total of $2.8-billion. The balance was for central systems.

Spokesmen for Air-Conditioning and Refrigeration Institute report that factory shipments of central systems during the first four months of 1959 rose 40% from the like period in 1958.

(Continued on page 8)

And in Denver — A FUTURE OF FAULTLESS SERVICE

Reflecting the phenomenal demand for prestige office space in rapidly expanding Denver, this recently completed 28 story COYNE & DELANY installation is the largest and tallest office building in the Rocky Mountain West. Erected at a cost of $10,000,000, the First National Bank Building offers the center of Denver's financial district a gleaming precast stone, aluminum, and glass exterior plus a roof designed as a heliport. Initiators of the project were the Murchison brothers of Dallas who, several years ago, constructed the Denver Club office building...another COYNE & DELANY installation...which has been unable to satisfy demand for space. For those who have lived with DELANY, there is no other flush valve. Leadership in design, unequalled nationwide service, eighty years of business integrity; all these factors spell DELANY— "the fastest growing name in flush valves!"

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DELANY *Flush* VALVES

SINCE 1879

WASHINGTON OVERTONES *(Continued from page 6)*

● Government's increasing interest in air conditioning was indicated by announcement of plans for a July 13-16 conference of Air Force personnel at Wright-Patterson Air Force Base, Dayton, Ohio.

Industry members were invited to attend and to meet with Air Force personnel responsible for policy, operation, maintenance and minor construction of refrigeration and air-conditioning equipment at Air Force installations throughout the world. The conference was arranged by William T. Smith, Chief of the Air-Conditioning and Refrigeration Section Headquarters, USAF.

● Not all of Washington's mid-year overtones are concerned with air cooling. Heating also has its place.

Typical of several hot subjects is the proposal to conduct a Coal Research and Development program. Industry, government and labor favor the objective. How to attain it builds the fires.

Two bills (S-49 and HR-6596) would create a Coal Research and Development Commission. A third measure (S-1362) also calls for "encouragement, stimulation and conservation of coal in the United States", but requires that the work be administered by the Bureau of Mines, Department of the Interior.

Administration favors the latter approach. So what happened in the House on May 12? By a vote of 251 to 54, the House approved legislation to create the new commission.

● Fuel oil also comes in for mid-summer consideration in Washington.

During the period July 1 to December 1, 1959, imports of crude and unfinished oil, finished petroleum products, and residual fuel oil in the United States and Puerto Rico will be leveled at 1,450,362 barrels per day, compared with 1,416,302 barrels per day during the period ending June 30, 1959.

The estimates for the last half of 1959 anticipate increased requirements due to population growth, with a comfortable margin for "unusually cold weather".

● Commercial standards for cast iron soil pipe, polyethylene pipe and plastic plumbing fixtures have been issued by the Commodity Standards Division, Department of Commerce.

CS 188-59 covers cast iron soil pipe and fittings, both heavy and lighter service weights, as requested by the Cast Iron Soil Pipe Institute. Price, 30 cents.

CS 197-59 covers flexible polyethylene plastic pipe, in accordance with recommendations of the Society of the Plastics Industry. Price, 10 cents.

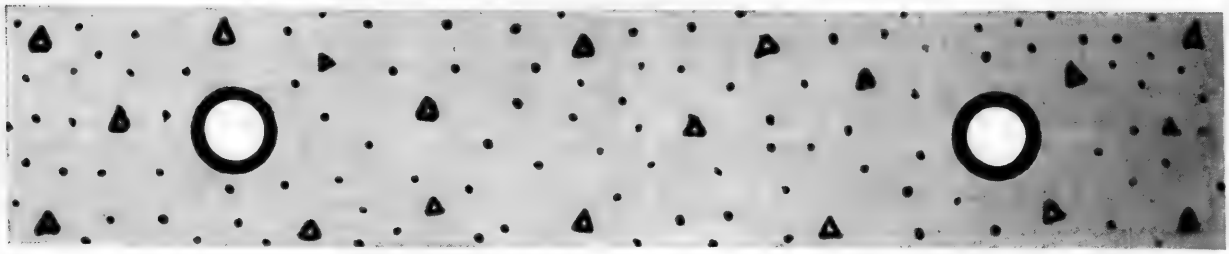
CS 221-59 and CS 222-59 were also plastics industry sponsored. The first covers gel-coated glass-fiber-reinforced polyster resin bathtubs; the second, gel-coated glass-fiber-reinforced polyester resin shower curtains. Copies of these standards are priced at 10 cents each.

All are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

● Producers of industrial air conditioning and heating equipment will find encouragement in reports that capital spending is on the upgrade. Expenditures for plant and equipment during 1959 are expected to be up 7% over 1958—totalling $32.6-billion. Previous Commerce-SEC estimates placed the increase at 4% for the year.

● One of the Washington area's first low-cost housing developments offering central air conditioning is being built in the Maryland suburbs. The development will include 1,100 row houses in groups of three units each, to sell from $9,450 to $9,950 per unit, with a few placed on larger lots, priced at $10,250.

4-D WROUGHT IRON PIPE



FOR SNOW MELTING AND RADIANT HEATING SYSTEMS

PROPOSAL FOR HIGH STRENGTH, CORROSION-RESISTANT INSTALLATIONS

New 4-D Wrought Iron has increased corrosion-resistance, improved mechanical and physical properties. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

Write for new 4-D Wrought Iron literature and specific technical information. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

PIPE: THE MOST IMPORTANT SINGLE COMPONENT—Pipe for snow melting and radiant heating systems *must* resist corrosion. It is only accessible for repairs at considerable cost and inconvenience. Any leaks that might result are frequently difficult to locate with any accuracy. It is also virtually impossible to avoid some rough handling during the course of fabricating and installing such systems. So, strength is another piping must.

EXPANSION COEFFICIENTS AND WORKABILITY—Pipe is exposed to wide temperature ranges in these services. So there's always the possibility of unequal expansion damaging surrounding material. The coefficients of 4-D Wrought Iron and concrete are identical. This minimizes the possibility of concrete cracking due to thermal expansion. Additional advantages of 4-D are: good bending properties and the sound, durable welds that can be obtained as a result of its self-fluxing action.

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BYERS 4-D WROUGHT IRON

NEWS OF THE MONTH

'DISCOMFORT INDEX'

draws protests from tourist industry. Many substitute names suggested. Weather Bureau bows.

A woman's longevity index (age) stops at 30. According to many in the tourist trade, the Discomfort Index in their localities never exceeds 75. For at that point more than half the people feel uncomfortable, a fact no more permissible to state than that a certain woman is "old."

The secret of eternal Spring is to mask the weather with a pleasant, euphemism, such as "Comfort Index", a suggested substitute for "Discomfort Index". The Weather Bureau in Washington, D. C., bowing to complaints, has adopted the noncommittal "Temperature-Humidity Index", but has left the decision on name change up to the individual weather stations. Next summer the Bureau will adopt one name to be used nationally, if it is decided to continue the index at all.

In addition to the pressure from business groups in several resort areas, the Weather Bureau admitted, several critical newspaper editorials were responsible for its switch of name. Public interest in the Discomfort Index will be evaluated by the Bureau in the fall. Twenty-four weather stations now compute the daily index. If the program is continued next year, it is expected that all stations will do likewise.

Other suggested names received by the Bureau include: Heat Moisture Index, Cooling Degree Index, Humitemp, Thermidity, Air Conditioning Value, Effective Heat Index, Human Reaction Scale, and Toler-Rate.

Actually, as explained in the June, 1959 Reference Data Sheet of this magazine, the Discomfort Index is Effective Temperature reduced to a formula. DI and ET values are very close for any set of simultaneous wet and dry bulb readings. The continuation of a table of DI values for simultaneous dry bulb temperatures and relative humidities appears in this issue.

Some sectors of the air conditioning industry see the Discomfort Index as an aid to sales. Allied Appliance Company, a Boston distributor of Fedders air conditioning units, for instance, has issued a blanket order to city newspapers and TV stations to run its Discomfort Index ad whenever the DI goes above 75. The Du Pont Company's Freon Products Division has published a chart of maximum DI values for selected stations during July, 1956.

USE OF COMPUTERS

in a new approach to control valve sizing to be discussed at Instrument Society Conference.

A New Approach to Control Valve Sizing is the title of one of many papers to be presented at the Conference of the Instrument Society of America, Pittsburgh, Pa., to be held in Chicago this year from September 21-25. According to the Society, the paper reveals a method by which, through the use of computers, previous errors in measuring valve sizes may be reduced by more than 25%.

As an indication of the speed of developments in electronic brains, Instrument Society officials have decided that at least twelve papers at conference technical sessions will be for the purpose of tutoring scientists and engineers on how best to employ computers to solve some of their problems. In many instances, papers at these sessions —to be known as computer clinics —will cover subject matter new even to recent engineering school graduates.

Technical sessions certain to attract major attention from the experts will be those dealing with the question of using computers in the control of industrial processes, since developments in this area rapidly are bringing many industries to the day of the automatic plant.

EXPANDED PROGRAM

planned by Steel Boiler Institute. Proposed merger with I-B-R off. New issue of rating code coming.

A proposed merger between Steel Boiler Institute, Inc., Philadelphia, Pa., and the Institute of Boiler and Radiator Manufacturers, New York, N. Y., has been called off in favor of new plans by SBI for expanded activities and programs, it was announced by Edmund J. Grady, newly elected SBI president and chairman of its Board of Directors.

Mr. Grady, who is also vice president of Pacific Steel Boiler Div., National-U.S. Radiator Corp., said the 31-year-old, 40-member manufacturers' association will enlarge the scope of its activities alone. "It was the feeling of the members at its recent annual meeting that a number of projected industry plans could best be carried out by SBI itself," he said.

Among these are plans for dealing with marketing, research, and engineering projects which dominated discussions by the Institute's membership, which accounts for 80% of the nation's steel firebox boiler production.

To help carry this workload, it was reported, the group is adding to its staff.

In the immediate future, it was announced by the Engineering Committee, L. N. Hunter, general chairman, a new issue of the SBI Rating Code will be released. It was reported that a new special section will list SBI Ratings for boiler-burner units.

In addition to Grady, other officers elected at the meeting were: vice president, Fred S. Hudson, Jr., National-U.S. Radiator Corp., and secretary and treasurer, R. A. Locke.

Elected to serve three-year terms on the Board of Directors were: A. J. Hall, Burnham Corp.; J. F. Johnston, Jr., Johnston Bros., Inc.;

(Concluded on page 14)

GOWER SCHOOL ADDITION, Hinsdale, Illinois. *Architect:* Wight & Schlaebitz, Downers Grove, Illinois.
Plumbing and heating contractor: Jerry & Phil's Plumbing & Heating, Inc., Brookfield, Illinois.

SUPERIOR ALL-COPPER PLUMBING IN THIS SCHOOL AT LOWER COST TO TAXPAYERS

COPPER SANITARY DRAINAGE LINES roughed-in among structural members at Gower School. This space-saving installation would have been impracticable with heavy, bulky pipe requiring threaded or caulked joints.

COPPER SANITARY DRAINAGE LINES for second floor lavatories at the Gower School. Light weight of copper tube and ease of making solder joints save many dollars on multiple installations like this. Compact assemblies eliminate wide plumbing walls, give greater usable floor area.

Phil Bergeron and Jerry Wehrmeister, plumbing contractors near Chicago, have found that the installation economies with copper tube and solder-joint fittings enable them to offer all-copper plumbing—water supply *and* sanitary drainage—at a cost lower than competitive bids based on installing ferrous piping. Recent jobs awarded to them as low bidder include the Gower School, the LaGrange Township Junior High School, a church, health center, two restaurants and a store. Anaconda was used for all these jobs. Phil Bergeron says, "We specify Anaconda Copper Tube and Fittings because their consistent fine quality and close tolerances makes our work easier and keeps the job costs within our estimates."

Contractors, builders, and architects the country over are finding that they can provide long-lasting, low-maintenance all-copper plumbing at a cost competitive with ferrous piping. For information on Anaconda Copper Tube and Fittings, write for a copy of Publication C-33. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8805

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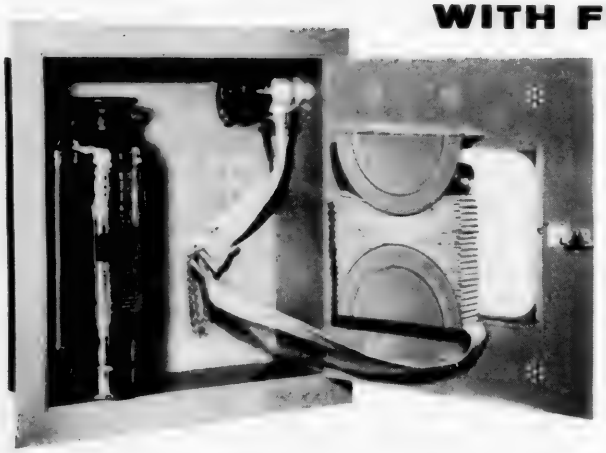
booklet gives basic fire protection requirements!

NEW! ALLENCO HOZEGARD

WITH FOUL-PROOF DOOR RACK!



Rack swings full 180°, never fouls hose line. Now, when seconds count, there's no delay in fire-fighting . . . user just grabs the hose and runs! The hose is racked on the cabinet door that swings out 180°. The foul-proof half-circle racks mean the hose can't snag when it's needed most. The new Allenco Hozegard cabinet, when specified with exclusive Hose Clip, is the first fire hose cabinet to be completely Underwriters' listed! Each Hozegard installation saves 25% to 30% by eliminating the expensive pin-type rack and the time to install the hose on it. Choose Allenco Hozegard cabinets with or without extinguishers and with Fire Department valve when desired. There are sizes and styles to fill most requirements. All have steel cabinet with frame welded to body and hold up to 100 feet of 1½" linen hose.

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Digest of Pertinent Sections of National Fire Codes (N.F.P.A.) with Drawings and Examples
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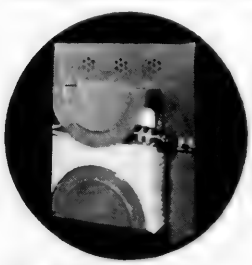
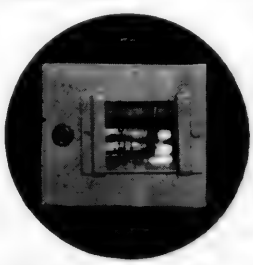
WRITE TODAY FOR THIS VALUABLE FREE BOOKLET! The W. D. Allen Manufacturing Company is anxious to help you provide adequate and dependable fire protection. The new Allenco FIRE CHECK BOOK is designed as a handy reference for your use in the selection and installation of such equipment. It shows the basic requirements for: Standpipe System; Hose Stations; Extinguishers; Exterior Centers. Prepared in convenient file size, the check book includes "coupon specifications" forms which simplify and speed spec-writing. Send for your free copy today; use the handy coupon below.



Free swinging door rack means foul-proof withdrawal and ready aiming at fire.

Exclusive hose clip makes cabinet semi-automatic—perfect for one-man operation.



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(Concluded from page 10)

and J. F. Sweeney, Titusville Iron Works Co.

Also announced was the completion of a corrosion testing program, conducted for the past several years at Babcock & Wilcox Company Tubular Products Division's laboratory. Findings pertaining to causes of internal boiler corrosion and methods of prevention have been compiled and will be presented shortly in publication form, it was reported.

At the Annual Meeting, a report was made on the sales results of the National Better Heating-Cooling Council's hydronic promotion drives. Henry Gibb, Pacific Steel Boiler Division, National-U.S. Radiator Corp., and chairman of the Council's Commercial and Industrial Task Force, outlined the new BHC Commercial and Industrial promotion program, citing the objectives of promoting hydronics in schools, apartments, office buildings and other commercial and industrial type structures. Gibb said BHC planned to operate this program separately from its current residential program.

SNOW MELTING SYSTEM

employed on sloping ramp at the new Air Force Academy, Colorado. Cadet safety is the aim.

An automatic snow melting system has been installed on a sloping ramp leading from the academic area to the parade ground of the new, $135 million Air Force Academy at Colorado Springs, Colo.

The system includes a network of wrought iron pipe grids embedded in the concrete ramp. A mixture of hot water and ethylene glycol is circulated through the piping. Heat radiates to the ramp surface where it melts snow and ice quickly.

The clear, dry pavement is expected to reduce slip and fall hazards during winter months—a lengthy period in this 8,000-foot high Rocky Mountain foothills area. The cadet trainees will frequently march up and down the ramp and the area will be clear and dry even when snow and ice blanket the remainder of the academy's 35-square-mile site.

Skidmore, Owings & Merrill, Chicago architectural firm, specified a sand fill base on existing grade for the 5,000-sq ft ramp. Piping of 4-D wrought iron, made by A. M. Byers Co., Pittsburgh, Pa., was used because of its high resistance to corrosive attack common in this service. The pipe was welded in a grid pattern and spaced on 14-inch centers by C. Wallace Plumbing and Heating Co., Dallas, Tex.

The wrought iron piping—which has a coefficient of expansion similar to concrete—was positioned 1½ inches below surface of the 7-inch thick concrete ramp slab. Before concrete was poured, the grid layout was hydrostatically tested at 200 psi for 24 hr.

A 44% ethylene glycol and water solution is heated to 135 deg F in a heat exchanger. A vertical split case pump circulates this mixture through the automatic snow melting system at 1,400 gpm.

MINES BUREAU

reports on costs studies for removing sulfur dioxide to lessen air pollution. Copy available.

Estimated costs for building and operating various types of equipment to remove harmful sulfur dioxide from flue gases of coal-burning powerplants in the United States were listed by the Bureau of Mines, Department of the Interior, as part of a study for the Public Health Service under the national air-pollution-prevention program.

The study centered on powerplants of 120,000-kilowatts capacity burning an estimated 475,000 tons of coal a year. Costs of installing scrubbing equipment to curb sulfur dioxide would range from $1.75 million to $5 million, depending on the gas-cleaning process used. Operating costs were estimated to range from $1.40 to $2.20 per ton of coal consumed. The operating cost would be lower if marketable byproducts were recovered from the furnace gases.

Bureau researchers point out, however, that credit for products obtained from the scrubbers should be allowed with extreme caution, because the materials—ammonium sulfate, sulfur, and sulfuric acid—might saturate the market and force prices down.

Three different liquid processes for removing sulfur dioxide from flue gases were listed by the Bureau: the limestone, ammonia, and the sodium sulfite methods. Without considering credit for byproducts, the Bureau said that investment and operating costs were lowest for the limestone process.

A publication describing the study, written by J. H. Field, L. W. Brunn, W. P. Haynes, and H. E. Benson points out that the rising consumption of fuels with relatively high sulfur content, particularly in heavily populated areas, has caused increased concern over atmospheric pollution by sulfur dioxide.

In studying the sulfur dioxide scrubbing problem, the Federal researchers found that many elements must be considered, including the amount of allowable sulfur dioxide that powerplants would be permitted to discharge, the sulfur content of the fuel used, and the varying prices for byproducts.

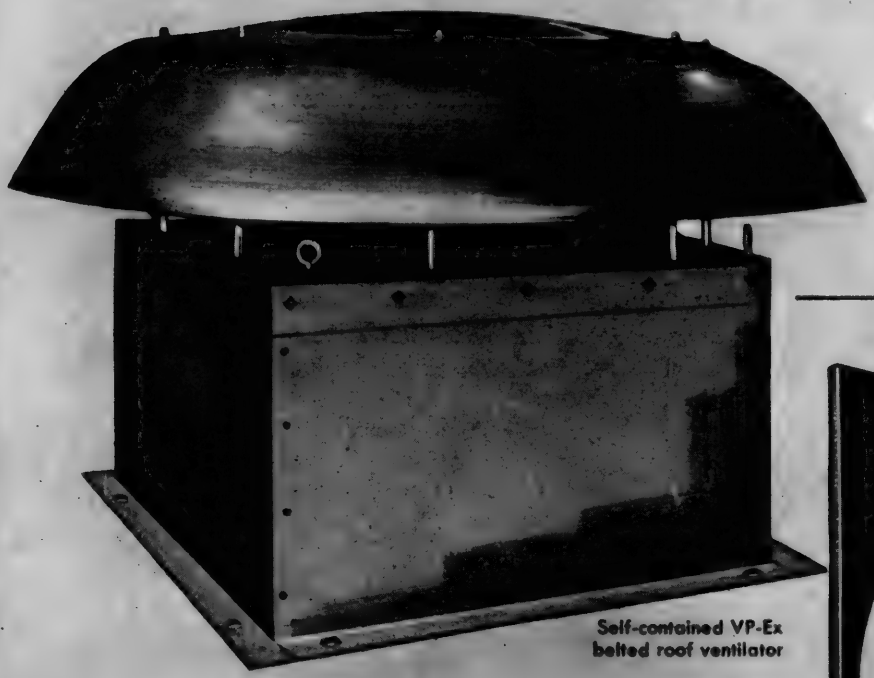
A copy of the publication, Report of Investigations 5469, "Cost Estimates of Liquid Scrubbing Processes for Removing Sulfur Dioxide from Flue Gases," can be obtained by writing the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa. It should be identified by title and number.

ASSE ANNUAL MEETING

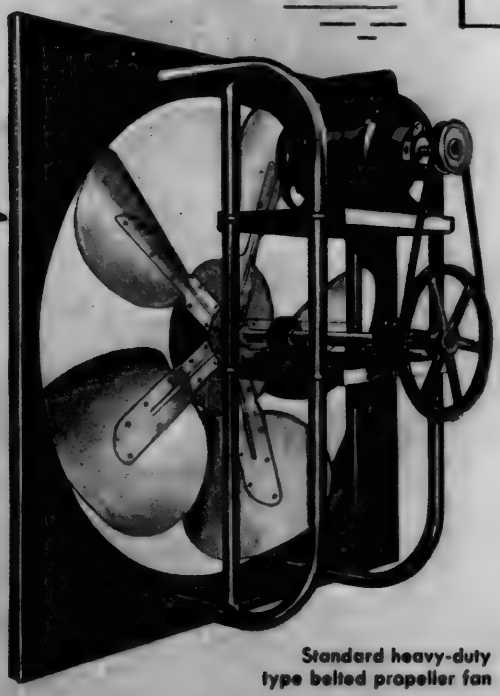
The 53rd Annual Meeting of the American Society of Sanitary Engineering will be preceded, as is the Society's custom, with a two-day Refresher Course, commencing at 9:00 a.m. Sunday, July 19. Registration for the meeting begins Saturday, July 18, at the Mayflower Hotel, Washington, D.C., with the opening session scheduled for Tuesday at 9:30 a.m. Adjournment will follow a business meeting on the following Friday. A full program of administrative and technical sessions will be leavened with a complete entertainment program.

VP-EX PROPELLER-TYPE

belted roof ventilator



Self-contained VP-Ex belted roof ventilator



Standard heavy-duty type belted propeller fan

The outstanding performance of the VP-Ex Belted Roof Ventilator is derived from insistence on quality at every step—from its galvanized construction through its complete industrial-type propeller fan. This large-capacity workhorse keeps overall height at a minimum while providing efficient operation and proper clearance between air discharge and roof. Capacities from 4450 CFM to 33900 CFM; also available in smaller direct drive sizes.

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Scientific Frontiers

• Design studies to test the feasibility of thermoelectric heating and cooling in shipboard air conditioning will be undertaken by Carrier Corporation under a contract from the U.S. Navy. The 18-month program contemplates preliminary design and analysis. Successful completion will lead to large-scale development of thermoelectric heat pumps, containing no moving parts, according to Dr. J. F. Downie Smith, research and development vice president of Carrier. Similar devices can be used to generate electricity directly from heat, also without moving parts. The importance of such vibration-free equipment to the Navy is underscored by another recent contract for Carrier to develop a 5000-watt thermoelectric generator.

• Atomic heat may be used in operating the government's second proposed saline water conversion demonstration plant, Secretary of the Interior Fred A. Seaton has announced. In reporting he had selected the multi-flash distillation process for the second plant (the first process being known as long-tube vertical multiple-effect distillation), he said that studies of the feasibility of using atomic heat for sea-water distillation are definitely promising, and that the Atomic Energy Commission has been asked to provide a low-temperature atomic reactor as the heat source for this plant. Dr. A. L. Miller, director of the Office of Saline Water, described the multi-flash process this way: In flash distillation, water is progressively heated and then introduced into a large chamber where a pressure just below the boiling point of the hot brine is maintained. When the brine enters this chamber the reduced pressure causes part of the liquid to immediately flash into steam. The remaining brine is passed through a series of similar chambers at successively higher vacuum where the flash process is repeated at progressively lower temperatures. Incoming cool sea water is used to condense the steam into the product water, thereby requiring less other heat for its own distillation.

• Any future long-term space vehicle or satellite that will contain men or delicate instruments must have an internal environment much as it is on earth, according to the Stanford Research Institute news bulletin, *Research for Industry*. As the vessel spins around in the void, one side will face the sun and absorb heat, while the other side will be dark and emit heat. The inside temperatures can be made to remain fairly constant and livable if the skin of the vehicle is a smooth reflecting surface which will reject much of the solar heat. But a satellite which is due to remain aloft for some time will run into several thousand micrometeorites on its journey through space. After a sufficient number of these collisions with tiny solid particles, the mirror-smooth surface of the vessel will erode, less solar energy will be reflected, and the satellite's interior will become excessively hot. Previously, methods to measure the amount of satellite erosion have been crude. However, a new technique, developed by physicist R. C. Goettelman, should detect damage caused by micrometeorites down to one one-hundred-thousandth of an inch. Goettelman would place a radioactive source within the satellite to emit beta rays focused at an angle onto the satellite's skin. Most of these rays pass through the metal, but a number of them hit the metal atoms and are deflected back into the satellite. A beta-ray counter correctly placed will receive and record this backscatter. Because the number of return particles is proportional to the thickness of the target area, the amount of backscatter will remain constant so long as the metal is intact. Any erosion of the metal will cause a lesser number of particles to be returned, and the counter will so indicate.

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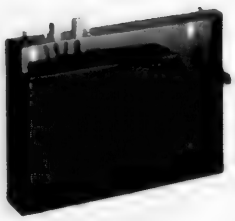
The Honeywell Pneumatic Round

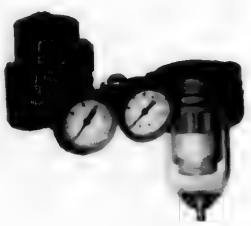
New examples of Honeywell's leadership in pneumatic controls—all perfectly matched for top performance

New Small Valves (V0520A and C; V0521A) For individual room temperature control. Newly designed, both valves incorporate a new rolling-type diaphragm actuator which greatly increases capacity and close-off ratings, in a compact size. V0521A (illustrated) is available in normally open, straight-through or angle patterns. For both steam and hot water applications.

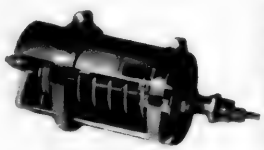
New Automatic Air Dryer (W025A2) For an improved primary source of dry control air. Only Honeywell offers a twin-bed dryer with automatic time programming for regeneration of the beds. Provides a reliable source of dry air, yet requires very little maintenance—an ideal solution to the problem of extracting moisture from compressed air supplied to the control system.



New Electronic-Pneumatic Relay (R07903 A and B) For precise control of conditioned air or water sources. Fully transistorized, the R07903 employs electronic sensing, pneumatic positioning—combines the sensitivity of electronic thermostats with pneumatic operators. Designed for summer or winter applications, with provision for both discharge and outdoor compensation.



New Pressure Reducing Valves and Filter Station (P0902 A and B) For better primary source of clean control air at the proper pressure. Advanced engineering and new design result in a fully integrated two-unit system—filter with transparent housing and replaceable filter element, and pressure reducing valve with built-in safety pressure relief valve. Plastic housing signals need for filter change by coloring when dirty.



New Piston Motors (M0903 A and B; M0904 A and B) For exact damper positioning. Brand-new pneumatic power unit for positioning dampers. Has rolling-diaphragm operation for high force output, long life. Universal mounting bracket permits external or internal installation on all makes of dampers.

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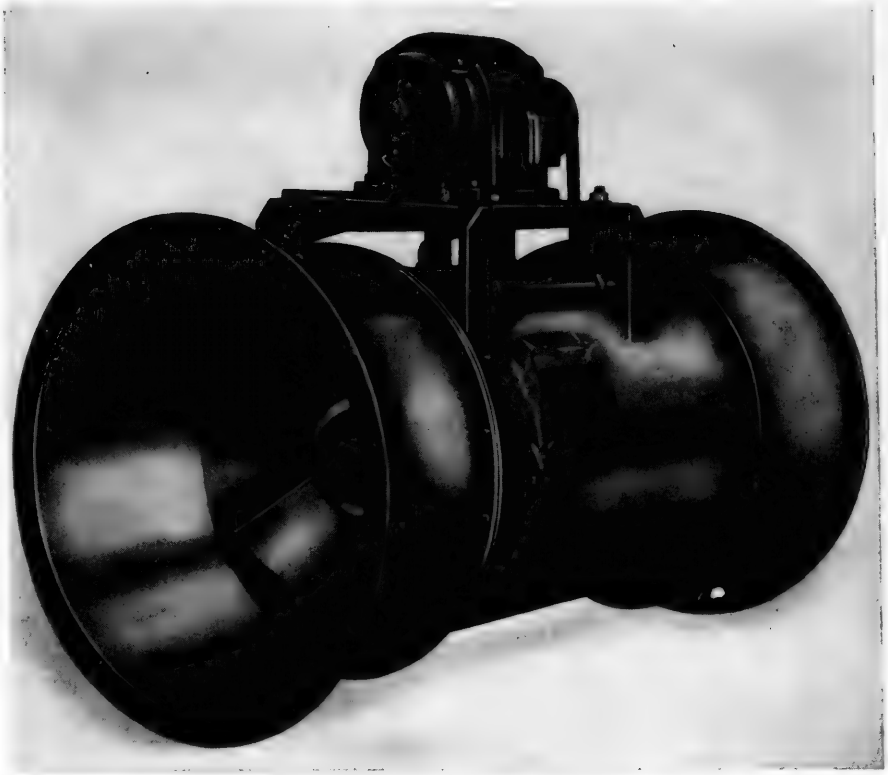

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"Buffalo" Axial Flow Fans are easily and economically installed because of their rugged, lightweight compactness. In all but the largest sizes, no heavy foundations or structural support are needed. "Buffalo" Axials can be installed as part of the pipe or stack in hood, vat and other roof exhaust systems.

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"Buffalo" Axials are quiet and highly efficient in many space-saving installations. These include paint spray booth exhaust, circulation of chilled air for quick-freezing, boiler room cooling, for supply and exhaust in textile plants, and many other uses. Choose from a wide variety of sizes and types to suit the needs of your installations.

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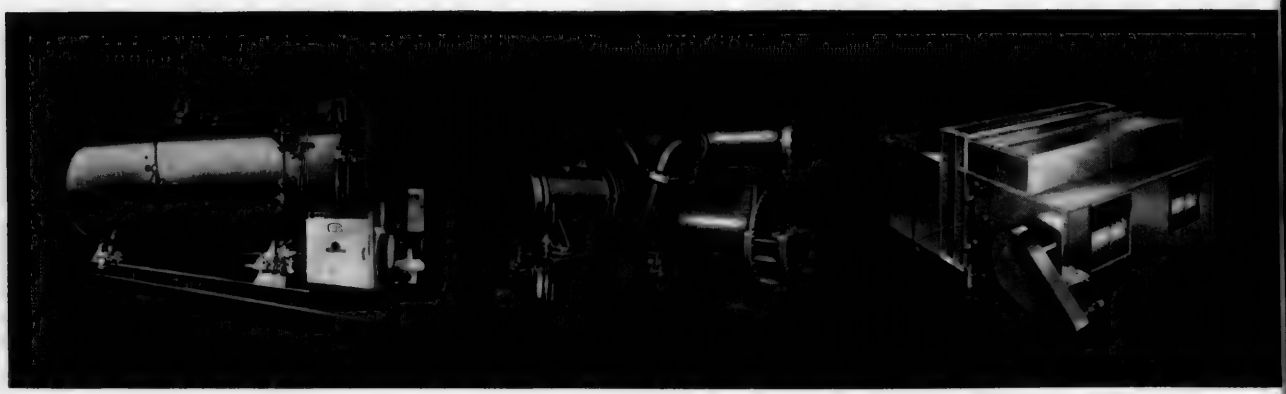

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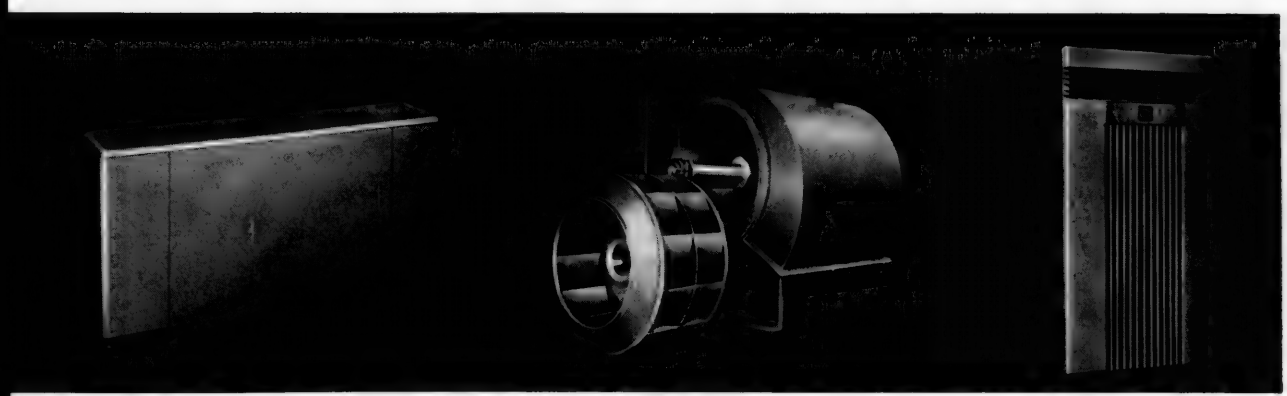

Fancoil units for cooling and heating individual rooms in multi-room structures.

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Packaged commercial air conditioners, air- or water-cooled types, 3 to 20 tons.

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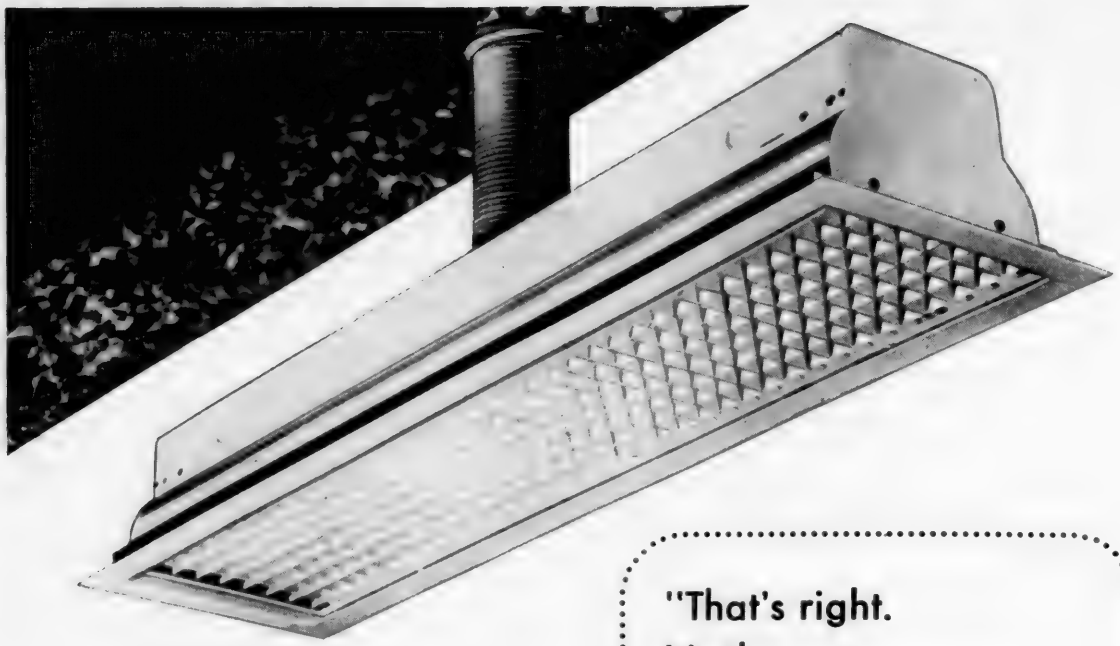

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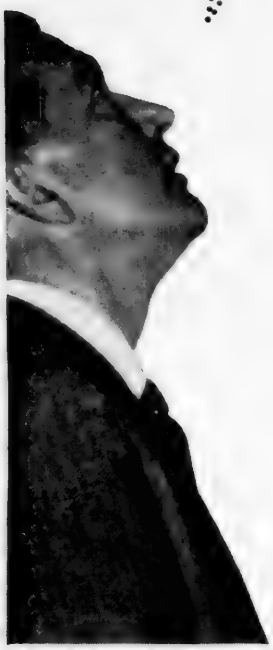

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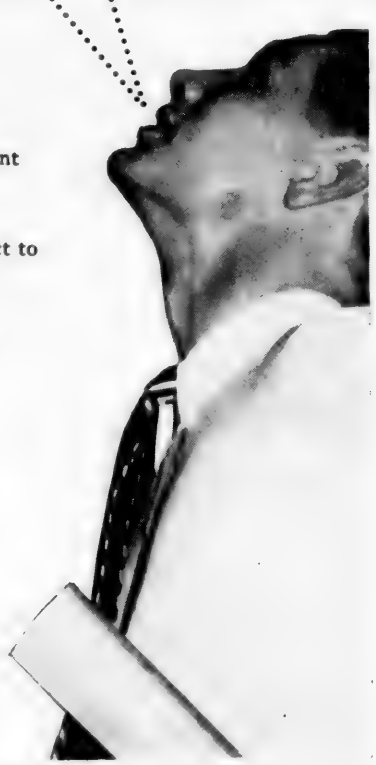
Write for detailed literature and the name of the representative in your area.



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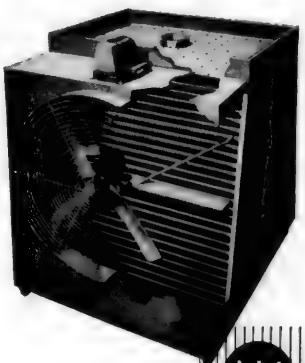

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The strikingly modern Hillside Church is one of four completely air-conditioned buildings in Rose Hills, Southern California's beautiful memorial park. Because of the liberal use of glass walls, and the desire for one central system, the air conditioning installation presented unique problems.

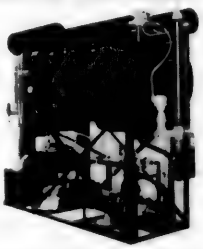
After a careful study, the Arkla-Servel gas absorptive cooling system was chosen. "And we're com-

pletely satisfied," says John D. Grigg, President. "Our 25-ton gas unit produces 10,000 cubic feet of cool air per minute. And you can't beat it for economy. It requires practically no maintenance. Since it uses the same boiler, it makes use of our heating facilities on a year-'round savings basis."

Gas absorptive cooling can put your heating plant on a year-'round economical basis too. For specific information, call your local gas company, or write to the Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Ark. *American Gas Association.*

GAS OPERATED ARKLA-SERVEL ABSORPTION-TYPE WATER CHILLER

- lowest operating costs
- fully automatic operation
- long dependable service
- packaged construction
- compact size
- easy installation



The MARSH way is the SURE way—

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

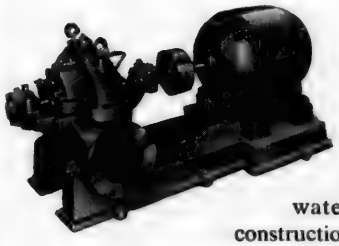
And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way... Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

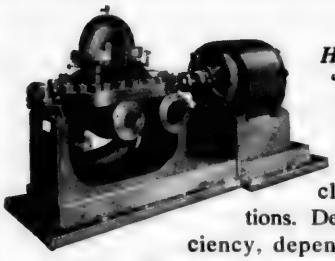
MARSH HEATING EQUIPMENT CO.
Sales Affiliate of Jas. P. Marsh Corporation
Dept. U, Skokie, Illinois
Marsh Instrument & Valve Co., (Canada) Ltd.
8407 103rd St., Edmonton, Alberta, Canada

MARSH *Heating Specialties*
SINCE 1865

HOW MUCH WILL IT COST YOU



Clear Water Pumps: "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



High Pressure Pumps: "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.

Non-Clogging Pumps: "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.

Heat Transfer Pumps: These special "Buffalo" pumps are engineered for handling high-temperature liquids. Rugged construction includes special alloys, water-cooled bearings and special packing. Single suction, solid shell design is highly efficient. Write for full details.

Chemical Liquid Pumps: These special "Buffalo" Pumps are engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Ten special types are available in a variety of trim. Write for Bulletin 982-A.

NOT TO INSTALL "BUFFALO" PUMPS?

How "Buffalo" Pumps Can Save You Money Right Away: "Buffalo" offers a broad line of pumps. This means you can usually choose the right pump to fill almost every liquid-moving need. With "Buffalo" Pumps you pay only for the type, size and capacity required — no more. This often means substantially lower initial cost.

How "Buffalo" Pumps Can Save You Money Over the Years: "Buffalo" Pumps are engineered for peak hydraulic efficiency. This gives you consistently lower pumping costs. "Buffalo" Pumps are ruggedly built throughout. Extra heavy-duty components reduce maintenance costs over a longer productive life span. "Buffalo" Pumps are designed for quick, easy access to inner parts. Thus routine maintenance costs are lower. "Buffalo" Pumps feature parts interchangeability. This means further savings in reduced parts inventories.

Your nearby "Buffalo" Engineering Representative will be glad to help you choose the pumps that will most economically fill your needs. Phone him today, or write us direct.

"Buffalo" PUMPS

BUFFALO PUMPS
Division of Buffalo Forge Co.
480 Broadway Buffalo, N. Y.

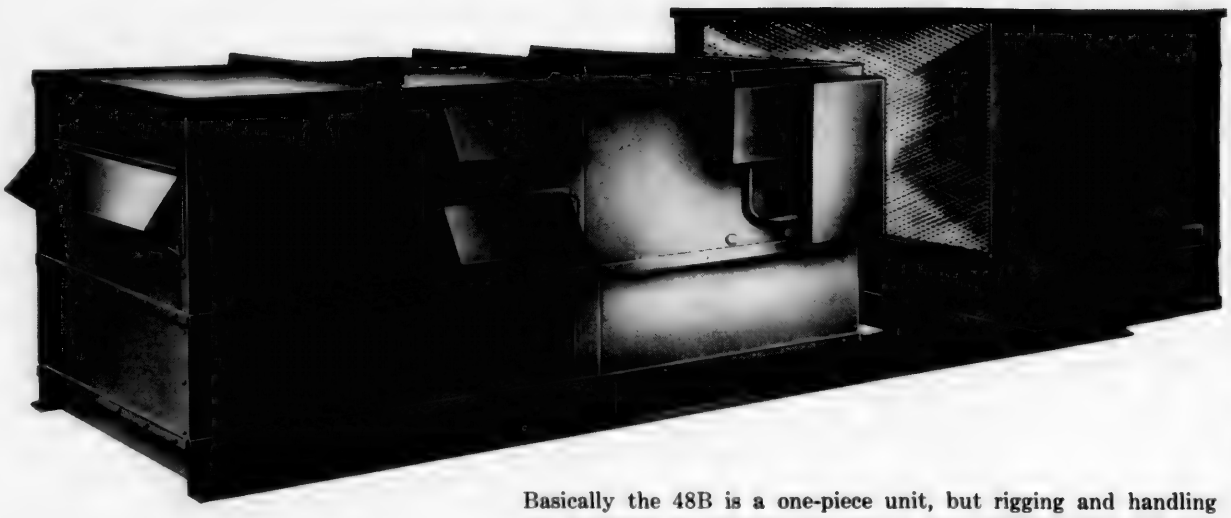
Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

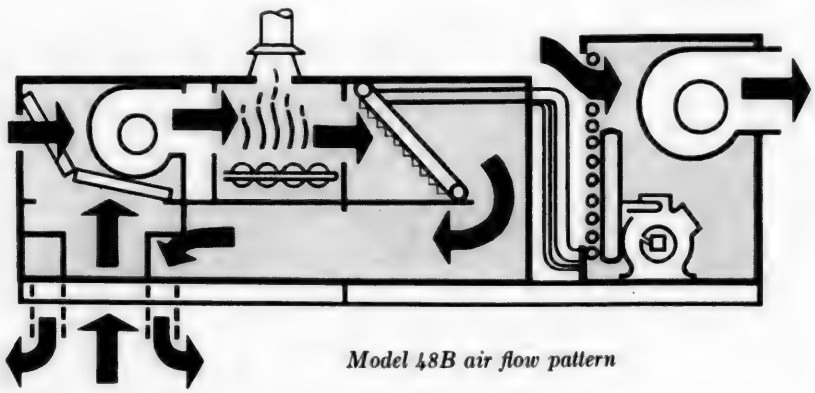
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

CARRIER AGAIN MAKES HEADLINES WITH A

NEW ROOF-TOP



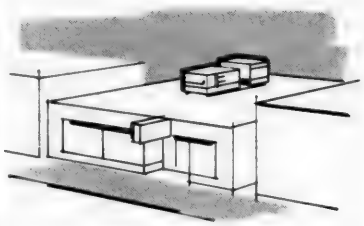
Basically the 48B is a one-piece unit, but rigging and handling are simplified by shipping the unit in two sections (base unit and fan section). It also installs with a single supply and return air duct, so only one duct passage must be cut through the roof. Installation is further simplified with only a single electrical power connection.



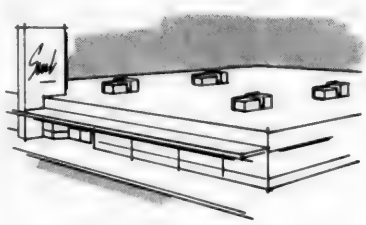
Model 48B air flow pattern

COMMERCIAL WEATHERMAKER

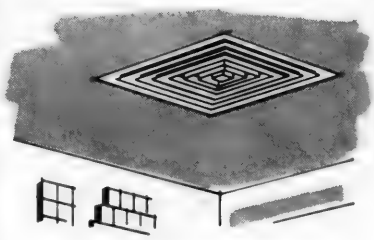
Puts both heating and cooling outdoors. Occupies no valuable floor space. Uses only a minimum of ductwork. Permits closer estimates, faster installation.



A single unit will both heat and cool a small store or plant



Larger buildings require two or more units to heat and cool



One supply and return air grille fits flush to ceiling

Here's the latest advance in heating and cooling for one-story buildings—the new Carrier 48B Air-Cooled Weathermaker*. Designed for roof-top installation, it provides the benefits of year-round air conditioning without extensive ductwork, without cluttering up ceilings and without tying up one inch of floor space. It gives you the opportunity to make closer estimates, reduces installation time and permits more installations with the same crew.

This versatile unit consists of a gas-fired heating section, a fan section and an air-cooled refrigeration section for cooling—all enclosed in a weatherproof casing and mounted on rails. Two capacities fit most heating and cooling requirements—7.5 and 10 tons for cooling; 200,000 and 250,000 Btus for heating.

The unit is factory charged, and refrigerant piping is installed. The compressor is protected by a five-year warranty. For more information call your Carrier dealer, listed in the Yellow Pages. Or write Carrier Corporation, Syracuse 1, New York.

*Reg. U.S. Pat. Off.

MORE PROOF OF
BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

BOTH HEAT AND HOT WATER FROM THESE WEIL-McLAIN TYPE "J" CAST IRON GAS BOILERS

ARCHITECT-ENGINEER
Allen T. Turpin Co.

GENERAL CONTRACTOR:
Carbone & West

MECHANICAL CONTRACTOR:
National Industrial Piping Co., Inc.

DISTRIBUTOR:
R. E. Newlin & Associates

Type "J" Boilers are available in these net I=B=R capacities:

Hot water, 375,100—3,105,600 BTU/hr.

Steam, 1565—12,940 sq. ft.

From coast to coast, Holiday Inns of America maintain the fine old inn-keeping tradition in a modern setting. One of the newest is the 175-unit Holiday Inn of New Orleans, located on the busy Airline Highway on the outskirts of the city. It provides all the conveniences of a modern, air conditioned hotel, including restaurant and lounge.

Two Weil-McLain Type "J" Boilers are installed. One J-16 furnishes heat for the entire Inn—one J-6 supplies domestic hot water for the complete system, including laundry and restaurant kitchens.

Type "J" Boilers offer 12 reasons for economy, dependability, long life

1. Made of corrosion-resistant cast iron.
2. A.G.A. approved minimum efficiency of 80%.
3. Develop full capacity as rated by I=B=R.
4. Compact design saves space—up to 40%.
5. A.G.A. approved for all gases.
6. Available with A.G.A. approved dual fuel manifold.
7. Electronic controls available as engineered part of unit.
8. Only a vent needed to carry off products of combustion.
9. Lower maintenance—easily cleaned, no refractories, no motors, no fans, no tube replacement, no water treatment.
10. Can be assembled at any stage of building construction. Sections pass through ordinary door.
11. Capacity easily increased by adding sections.
12. Wide range of capacities permits accurate sizing.

Write today for complete information or see listing in Sweet's Architectural File or Engineers Product File.

WEIL-McLAIN BOILERS · RADIATORS

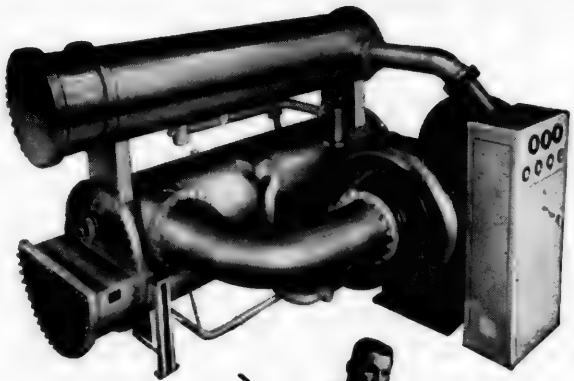
WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. BB-79

Climate by Chrysler

...most versanomical way to air condition anything!

Versanomical—that's the word for Chrysler's Centrifugal Water Chiller. It's versatile: engineered for any air conditioning project from 125 hp to the largest. And economical: packed with special engineering features that cut operating and service costs. For example:



1. **True volute casing.** A Chrysler design exclusive that minimizes refrigerant turbulence . . . reducing horsepower load on the motor.
2. **Adjustable guide vanes.** Unique airfoil design employs new principles to increase compressor efficiency to the maximum while maintaining operating stability.
3. **Automatic operation.** Factory-assembled control console including all required safety controls, indicator lights and gauges.
4. **Automatic purger.** Removes non-condensable gases and water vapor. Prevents contamination of refrigerant system, cuts service costs.
5. **Interlocked lubrication.** System protects motor bearings with a constant flow of oil. Compressor can't run unless oil pump operates.

Chrysler Centrifugal Water Chillers are factory pre-tested under simulated operating conditions to assure peak performance. Get complete engineering data and technical assistance from your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corporation, Dept. I-79, Dayton 1, Ohio.

CHRYSLER AIRTEMP

FIRST WITH THE FINEST IN AIR CONDITIONING

THE MASSACHUSETTS LINE®

OF FANS AND BLOWERS

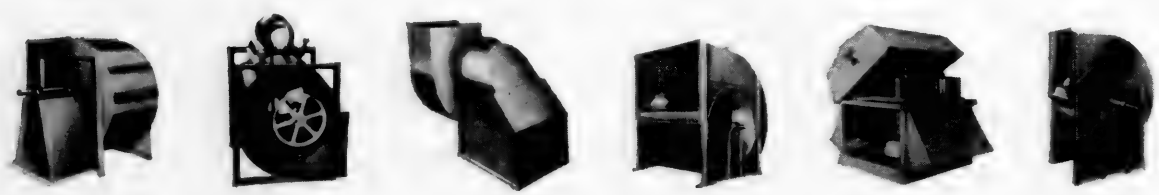
BIGGER and BETTER than ever!

RECENTLY, The Peerless Electric Company, Warren, Ohio, manufacturers of fans, blowers and motors, acquired The Massachusetts Line of fans and blowers, which were formerly the products of The Bishop & Babcock Manufacturing Company, Cleveland, Ohio.

Peerless Electric is now manufacturing the same Massachusetts fan and blower items which were produced at Cleveland, Ohio. Engineering data books, performance tables, dimensions and other construction characteristics still apply.

IN MOST localities, the same manufacturer's representatives will sell The Massachusetts Line. They, and The Peerless Electric Company, invite your inquiries and solicit your business as in the past. You can be well assured that The Peerless Electric Company will manufacture the same high-quality Massachusetts product. Peerless Electric will do all that is possible to offer effective service to its representatives, consulting engineers, contractors, OEM accounts, dealers and distributors.

We welcome the opportunity to sell you The Massachusetts Line
Write today for catalogs and other descriptive literature.



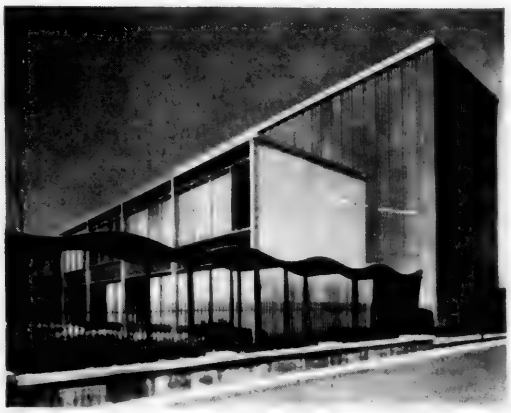
The MASSACHUSETTS LINE®

A DIVISION OF THE PEERLESS ELECTRIC COMPANY

WEST MARKET STREET • WARREN, OHIO

Member of the Air Moving and Conditioning Association, Inc. (AMCA)

Pneumatic Control Center Serves Dual Purpose in New H. H. Robertson Co. Building



H. H. Robertson Co., Ambridge, Pa. Oscar F. Wiggins, architect, New York; Wm. A. Rose Associates, mechanical engineers, New York; Martin W. Wise, general contractor, Sewickley, Pa.; McCarl's Plumbing & Heating Co., Beaver Falls, Pa.

Top feature of H. H. Robertson Co.'s new office building is Robertson's own new dual duct air conditioning system, for which it developed the Aerator Mixing Unit and Q-Air Floors that carry hot and cold air to the units.

Shown above is the Johnson Pneumatic Control Center from which the system is supervised and controlled. Operational features of this specially designed panel include *continuous* indication and remote adjustment of fan speeds, temperatures and pressures; graphic representations of the system and its controls; optional recording of key temperatures and pressures; and start-stop switches for all equipment.

Although a comprehensive control panel such as this is not required for the normal operation of a Robertson Q-Air Floor System, it was installed in this case to obtain essential performance data for the guidance of Robertson research engineers. And, as nothing else could, it gives a clear, dramatic demonstration of the Robertson system to engineers, architects and other visitors.

Wherever quality is the key consideration, as it obviously is here, the chances are you will find a pneumatic control system by Johnson. A nearby Johnson engineer is ready to help you give your clients the very best. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

TEMPERATURE & AIR-CONDITIONING CONTROL SYSTEMS FOR COMMERCIAL, INDUSTRIAL & PUBLIC BUILDINGS—AND SHIPS

CLARAGE

ARCHITECT
Jose Aspe

CONSULTING ENGINEER
Leo Lickerman

DESIGN AND AIR CONDITIONING CALCULATION
Calefaccion y Ventilacion, S.A.

CONTRACTOR
Calefaccion y Ventilacion, S.A.

Forward striding Mexico...

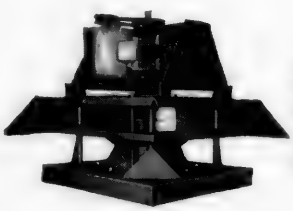
another land where Clarage gives air a lift

World-wide, Clarage quality is known and called upon. Down Mexico City way, for example, is the new Palacio de Hierro.

Here, in this city's largest and most modern department store, Clarage air handling and conditioning equipment is at work — Capillary Air Washers and Centrilator Power Roof Ventilators. Why is Clarage so often selected for buildings of all types, all sizes? Largely because of this equipment's reputation for faithful performance and operating economy.

Contact our nearest sales engineering office. You too will find it's characteristic of Clarage products to prove out successfully no matter how challenging the requirements.

REQUEST CATALOG 405 covering the Clarage Capillary Air Washer. Equipped with capillary cells. Three arrangements available. Capacities 4,400 to 132,000 CFM.



REQUEST BULLETIN 550 covering the Clarage Centrilator Power Roof Ventilator. Static pressures to 2"; capacities to 26,400 CFM. (Unit shown here without cover.)

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

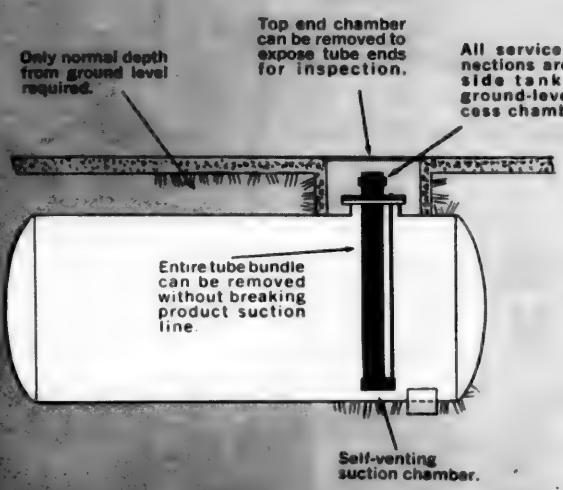
NOW...for underground fuel oil storage tanks—
a tank suction heater with easily accessible service connections

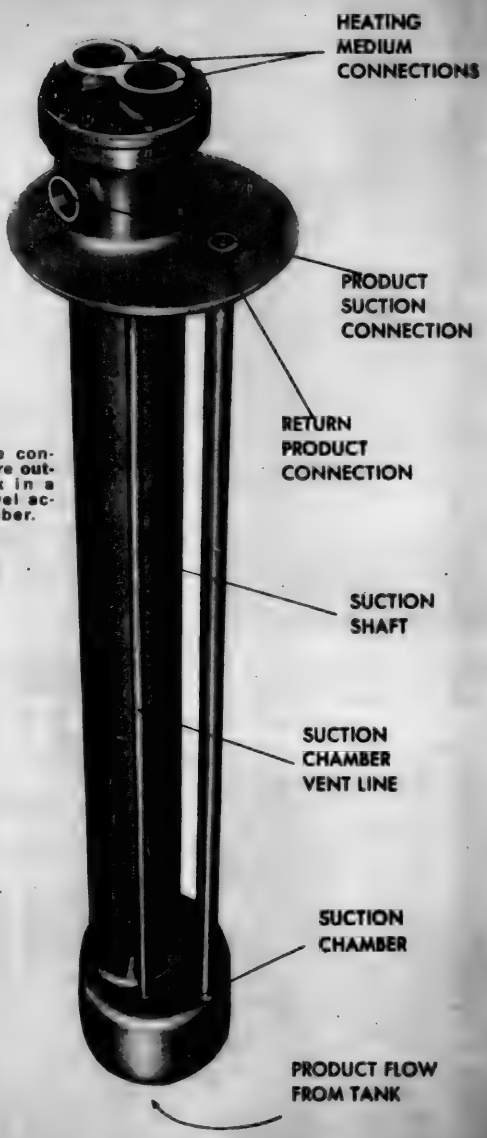
PARACOIL "VUF"
VERTICAL TANK SUCTION HEATER

Designed to simplify both installation and service. Heater is suspended from tank manhole flange. **All connections are outside the tank.** A new Paracoil invention.

Uses hot circulated fluids as heating mediums — insuring positive suction temperatures.

The simplest method of preheating fuel oils and other viscous liquids in underground storage tanks.


Only normal depth from ground level required.
Top end chamber can be removed to expose tube ends for inspection.
All service connections are outside tank in a ground-level access chamber.
Entire tube bundle can be removed without breaking product suction line.
Self-venting suction chamber.



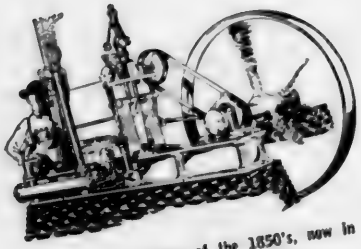
Hot return product mixes with fresh product in suction chamber, providing an initial temperature rise even before the heating tubes are reached.

Available in standard sizes and capacities for various product fluids.

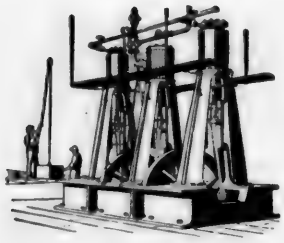
A Product of

DAVIS ENGINEERING (A Division of American Metal Products Company)

520 Main Avenue, Wallington, N. J.



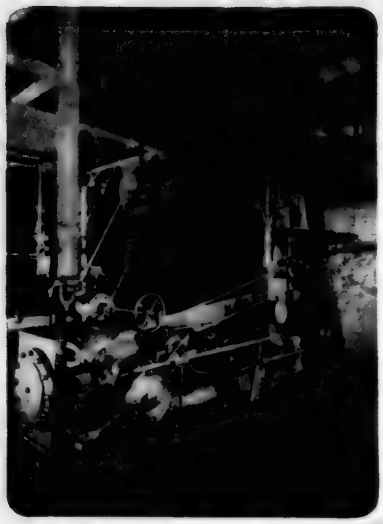
Frick steam engine of the 1850's, now in the Ford Museum.



Ammonia compressor built in 1883.

Built in 1896, this giant refrigerating machine had 350 tons capacity—then the world's largest.

TRADE FRICK MARK®



ONE NAME . . .

One Independent Company, One Standard of Excellence Since 1853

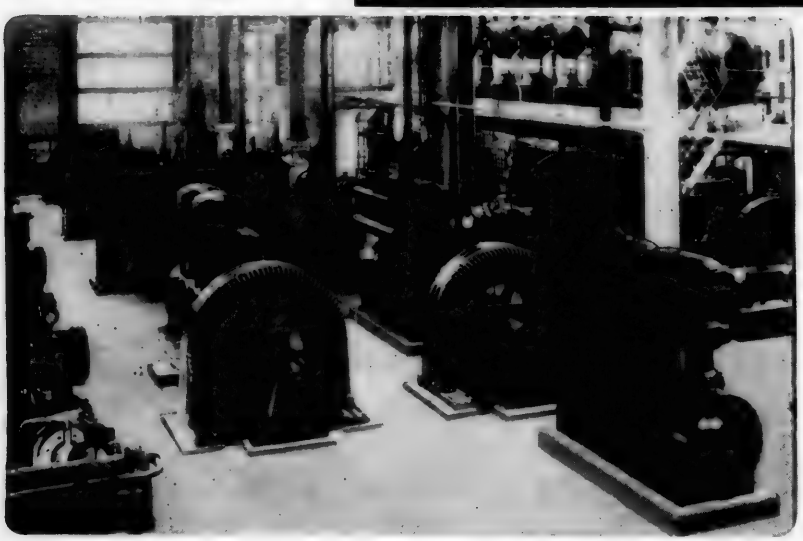
We're decidedly in business at the old stand, under the same experienced management as heretofore, and welcome the chance to serve both old and new customers. Let us quote on your air conditioning, refrigerating or ice-making needs: write . . .

Steam-driven compressor installed in 1887 at Gipps Brewery, Peoria, Ill. In service 60 years.

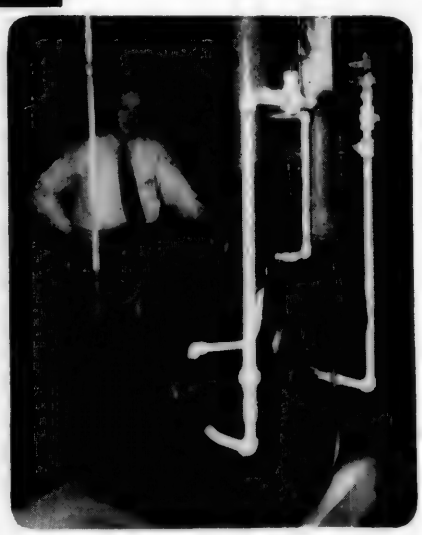
WAYNESBORO, PENNA., U.S.A.

FRICK CO.

This enclosed type ammonia compressor introduced in 1915, was used at Spath's Market, Portland, Ore., until the 1940's.

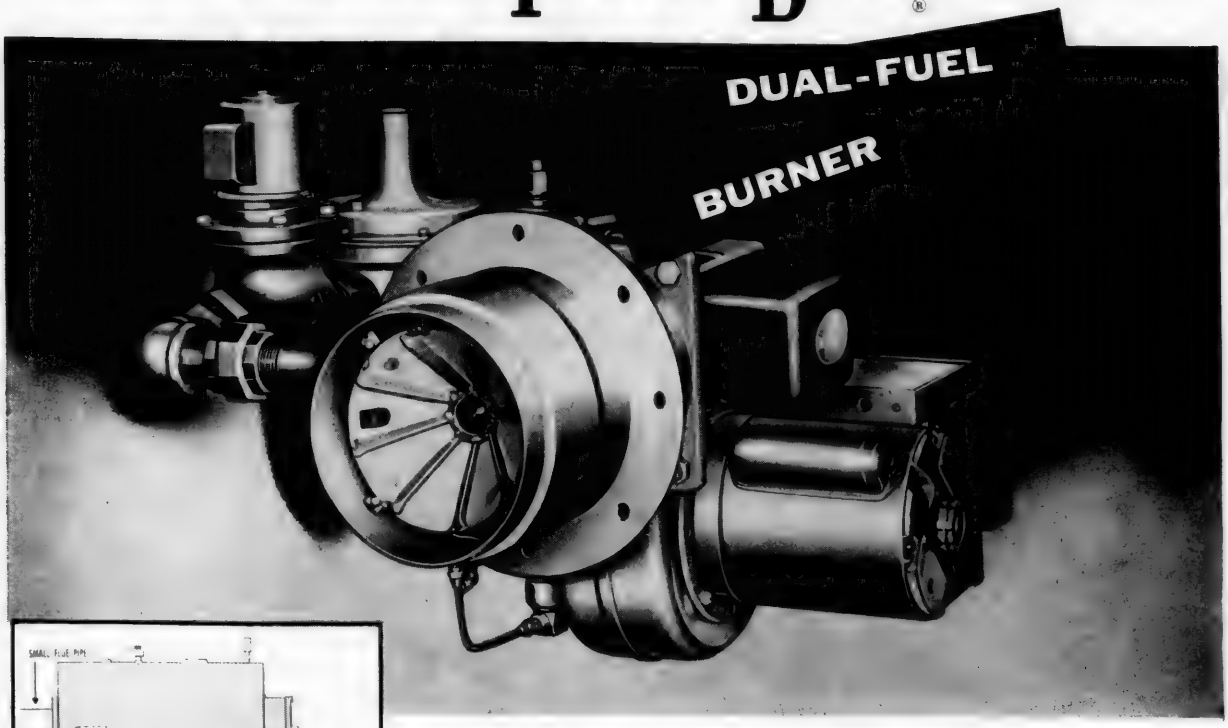


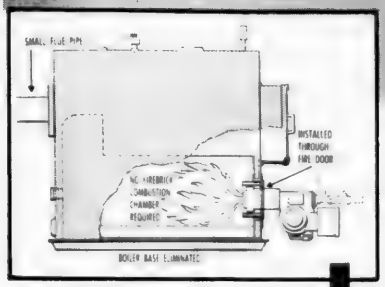
The Celanese Corp. uses 10,000 tons of refrigeration in its plant near Cumberland, Md. Here Frick heavy-duty compressors have operated 30 years.



"ECLIPSE" compressors, with 2, 3, 4, 6 or 9 cylinders, handle any refrigerant, at any temperature, on any load.

NEW PETRO PowerBlast®





Needs no firebox refractory

Burns clean in less than 10 seconds

No high stack

Greatly reduces standby heat loss

Costs much less to install

For steel firebox boilers

Needs no firebox refractory!

Until now, oil firing has required refractory lining in the firebox to "support combustion," which simply means that an old-style burner does not burn the fuel completely without the reflected heat from the hot bricks. Burners requiring these combustion chambers produce smoke during the starting period. Accepted industry standards allow up to 15 minutes warm up. Incomplete combustion is evidenced by soot deposits on heating surfaces and is a source of atmospheric pollution.

The notable fact about this new Petro PowerBlast firing system is that the burner itself achieves complete combustion immediately with either gas or oil, without depending on reflected heat. It burns clean in a cold firebox in less than ten seconds.

Since there is no heavy brickwork to store heat (and due also to the burner design) standby heat loss is reduced to practically nothing. As every heating man knows, this eliminates the source of a very substantial fuel waste.

We have described but one feature of the remarkable new Petro PowerBlast burner. There are many others. Mail coupon for further information.

PETRO
T. M. REG. U. S. PAT. OFF.
Makers of quality heating and power equipment since 1903

PETRO
3327 West 106th Street, Cleveland 11, Ohio
(In Canada: 80 Ward Street, Toronto, Ontario)

Please send me literature and specifications on the Petro PowerBlast dual-fuel forced draft burner.

Name .....
Company .....
Address .....
City ..... Zone ... State .....

ON LAWLER TYPE "S" TEMPERATURE REGULATORS! LOOK AT THE TEST! LAWLER PINPOINTS CONSTANT THERMOSTATIC CONTROL!

DIRECT ACTING—protects against overheating . . . a rise in temperature closes the valve.

REVERSE ACTING — for cooling systems and recirculating lines. Rising temperature opens valve . . . drop in temperature causes valve to close.

THREE WAY—mixes hot and cold liquids.

Wherever highly accurate thermostatic control is vital, you'll find Lawler Type "S" Temperature Regulators at work.

Advanced engineering design . . . skillful manufacturing have been Lawler's trademark for the greater part of a half century of solving thermostatic control problems.

The Type "S" features a highly sensitive liquid filled thermostatic element for instant activation . . . stainless steel sliding parts for long-lived friction resistant operation.

WHEN PRECISION PERFORMANCE COUNTS LOOK TO LAWLER FIRST!

LAWLER AUTOMATIC CONTROLS, INC.
MT. VERNON NEW YORK

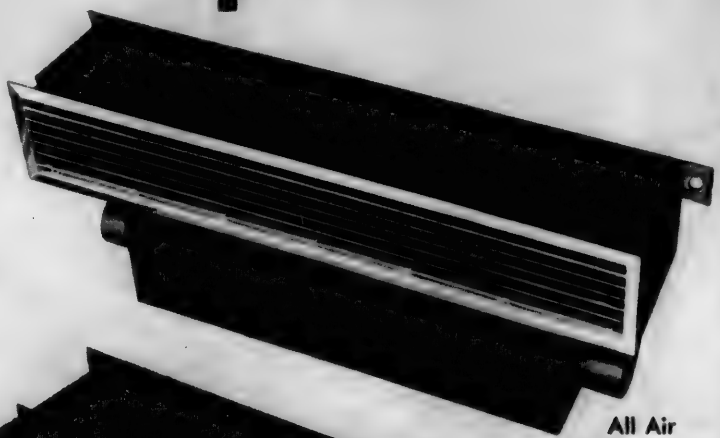
ANEMOSTAT®

is a registered trademark for a wide range of air diffusion equipment

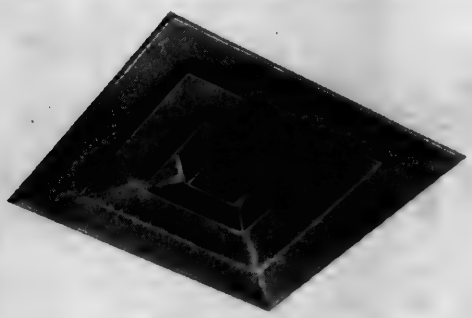
Today Anemostat offers an impressive variety of air diffusion equipment to meet every architectural and engineering requirement. ANEMOSTAT® is a registered trademark. It is your guarantee that every unit bearing this name is of highest quality . . . backed by the most experienced engineering, research and testing laboratories in the industry.

When Anemostat Air Diffusers are in sight the system is right. This was true yesterday, is true today and will be true tomorrow.

Conventional Air Diffusers



All Air High Velocity Systems



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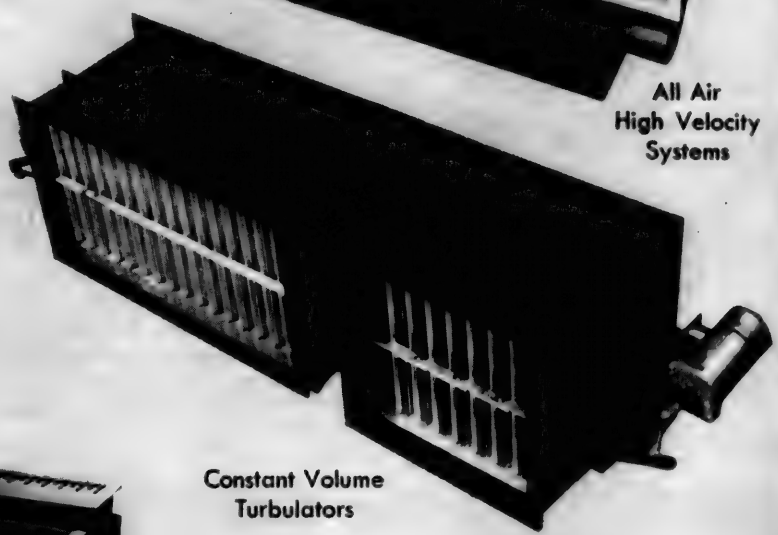

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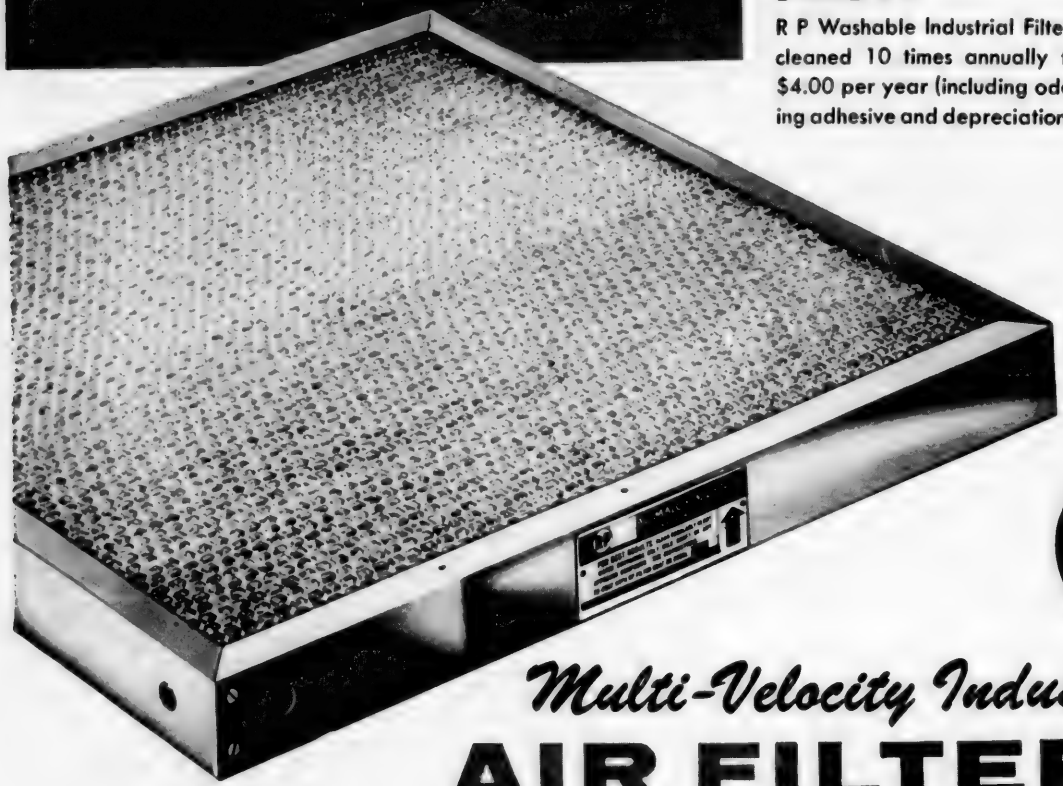

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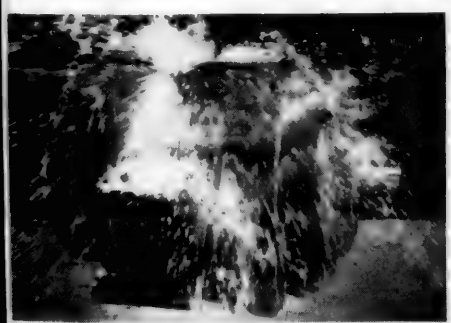

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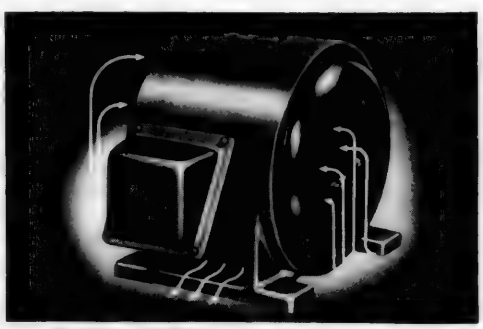

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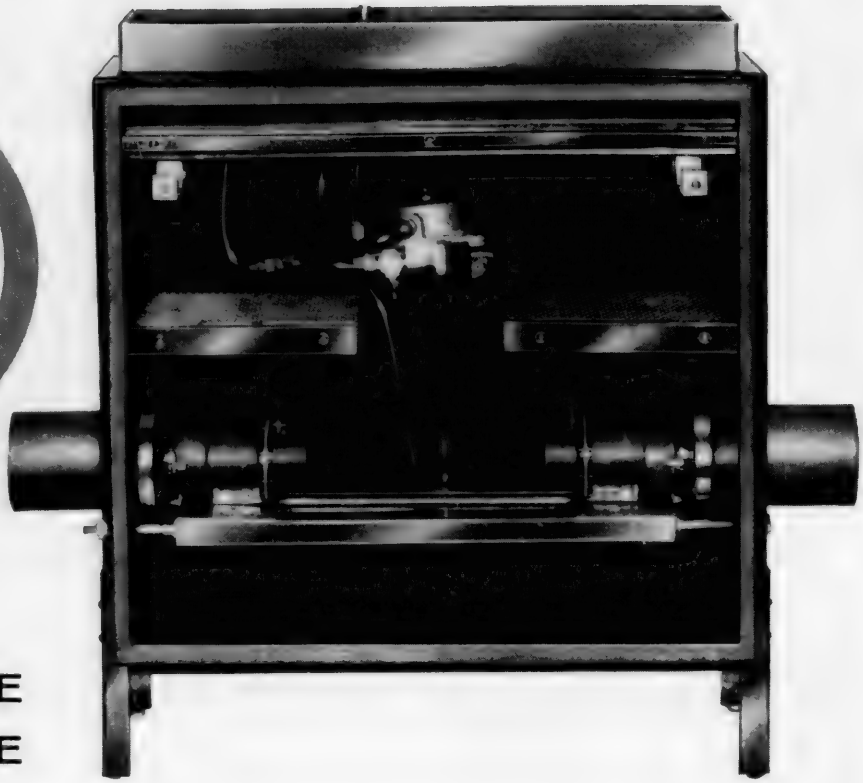

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

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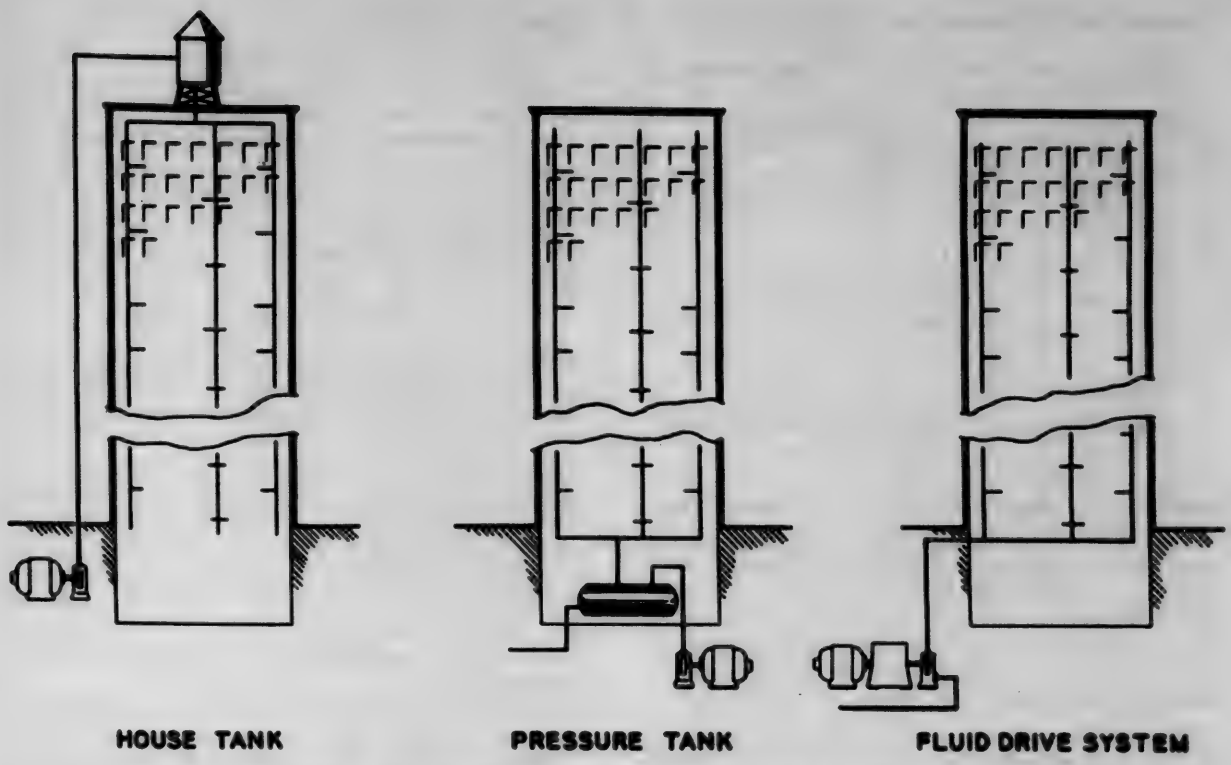


Fig. 1. Three systems for maintaining pressure-volume requirements in house pump applications.

Fluid Drives for House Pumps

C. L. ARNOLD
Application Engineer
American-Standard Industrial Division

A quiet revolution has taken place in the control of service water systems for multi-story buildings. It is based on the use of adjustable speed fluid drives for house pumps to maintain system pressure-volume requirements, and it is intended to replace both house tank and pressure tank methods. Here is a report on the operation and advantages of fluid drives in house pump applications.

THE use of adjustable speed fluid drives to maintain pressure-volume requirements for house pump applications is the latest advance in the control of service water systems for multi-story buildings. The fluid drive system is simple, compact and relatively inexpensive.

Although the concept is a relatively new one (the original installation was made in Chicago in November, 1957), it is based on sound engineering principles and has much to offer the engineer responsible for plumbing system specification in a multi-story building. It is intended to replace both the house tank method and the pressure tank method, the only arrangements heretofore available to the engineer. The three methods are compared schematically in Fig. 1.

SYSTEM COMPARISON

The fluid drive house pump system avoids the gradual drop followed by rapid rise in pressure, which is typical of other systems. The steady pressure characteristic minimizes or eliminates potential water hammer, simplifies fixture design and otherwise avoids undesirable effects. Its smooth and regular operation avoids vibration and noise, making it a most popular system from the point of view of the building occupants.

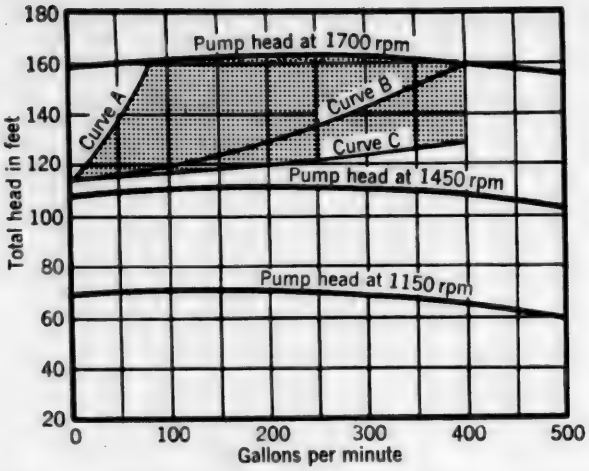


Fig. 2. Typical pressure-volume curves for three different system conditions. To meet system pressure-volume requirements, the pump must operate at all points within the shaded area on the chart.

House Tank Method

In comparison to the house tank method, the fluid drive system eliminates the need for a tank. This means a savings in initial tank cost as well as maintenance costs incurred from the need for periodic cleaning. In addition, the vermin problems normally associated with a house tank installation are eliminated. Equally important to the architects and engineers responsible for design of a building is the fact that elimination of the house tank often reduces the structural requirements of the building itself, permitting a simplified structure with attendant cost savings.

A significant difference between the fluid drive system and the house tank system is found in the pump size requirement. Pumps used in conjunction with house tanks traditionally have been sized to fill the tank in 15 to 30 minutes. Since the tank is usually designed to be capable of supplying the normal system demand for a period of from two to four hours, house tank system pumps are sized to handle from 4 to 8 times the normal demand.

Pumps used in the fluid drive system, on the other hand, need have a design capacity no greater than the calculated maximum demand. With pumps of optimum size, the unnecessarily high investment of oversize pumps is avoided. Pumps used in fluid drive systems operate continually under conditions for which they are best suited. The net result is excellent control, high motor efficiency and optimum motor power factor.

Pressure Tank Method

Compared with the pressure tank method, the fluid drive system eliminates the pressure tank, air compressors and associated equipment. Doing away with the air system avoids potential aeration of the water and attendant corrosion problems. In addition, the compactness of the fluid drive system conserves valuable basement floor space. For a typical installation, operating components occupy 60 to 80% less space as compared with a pressure tank system meeting the same operational requirements.

THE PRESSURE-VOLUME PROBLEM

The requirement of any water system is to maintain uniform design pressure at the various outlets in the system at all times. The multi-story system presents a complex problem of constantly varying pressure-volume requirements, since the numerous outlets are periodically opened and closed at random. The length of time a given outlet will remain opened or closed is unpredictable. The degree to which outlets will be opened varies from outlet to outlet and from cycle to cycle, and the possible combinations of outlets which may be opened at one time are many. Because of this, the pump must satisfy the needs of a system that is continually varying in volume and pressure.

Volume in a system requiring a house pump will fluctuate to a much greater degree than pressure. This is because most of the available pressure is utilized to overcome head due to height and to provide a "static pressure" which must be maintained at the highest, most distant outlet. The balance of the pressure requirement is made up of line losses, which vary as the square of the flow. A single-building installation will have relatively small line losses, while a multi-building development with associated long runs of piping will have proportionally higher line losses.

The problem in terms of house pump requirements is expressed in Fig. 2 which shows typical curves for the load imposed on the pump for three different representative system conditions. In Curve *A*, a small number of very distant outlets are open; in Curve *B*, a large number of uniformly distributed outlets are open; and in Curve *C*, a large number of outlets near the pump are open. To meet system pressure-volume requirements, the pump must be capable of operating at all points within the shaded area on the chart. This can be accomplished by varying the pump speed. In the typical system curves in Fig. 2, a pressure of 115 ft must be maintained at all times to provide the required minimum pressure at the most remote point in the system.

THE INSTALLATION

Mechanical arrangement of the equipment is straightforward in the fluid drive house pump installation. Con-

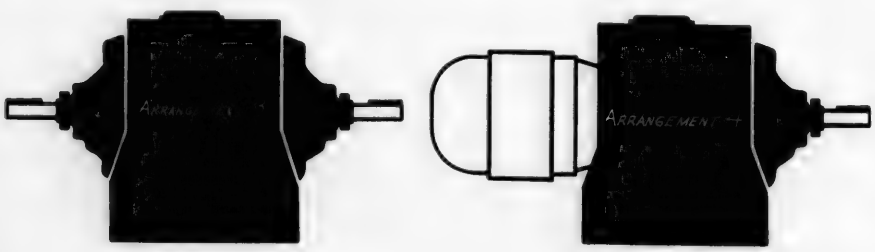


Fig. 3. Fluid drive coupling arrangements can be either of those shown. Arrangement 4 utilizes direct-coupled motor.

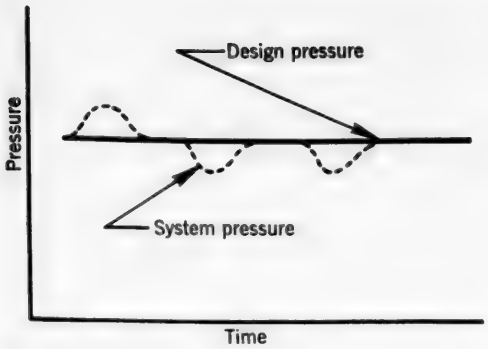


Fig. 4. Proportional control system senses a pressure change and begins to correct for it as soon as change occurs.

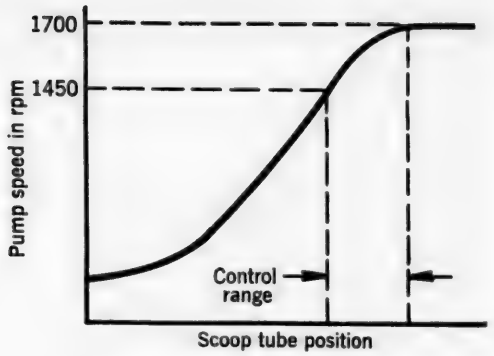


Fig. 5. Typical curve charting pump operating speed against fluid drive scoop tube position.

stant-speed electric motor, fluid drive and pump are mounted on a common subbase and connected through flexible couplings. Mounting arrangement No. 3 or No. 4 may be used (Fig. 3). Where direct-coupled motor is used, as in arrangement No. 4, the subbase is shortened and one flexible coupling is eliminated.

PRESSURE CONTROL

Since the purpose of the house pump system is to maintain a constant pressure, some sort of device must be employed to sense pressure variations. A system in which pressure sensing switches control fluid drive output speed, hence pump operating speed, is one method that has been used in house pump applications.

Pressure Switch Control

Two switches are used in the pressure switch system. One closes its circuit when predetermined maximum pressure is reached; the other closes its circuit when system pressure drops to a predetermined minimum. The generally recommended minimum-to-maximum pressure differential is approximately 5 ft. The fluid drive system is designed to maintain pressure within this control range.

A control motor is mounted on the fluid drive. When operated in one direction, the motor slowly withdraws the scoop tube from the oil circuit. This action increases pump speed. When energized in the opposite direction, the motor pushes the scoop tube into the oil circuit, decreasing pump speed.

Pressure switches are wired to the control motor. When the predetermined maximum pressure is reached, the maximum pressure-stat closes, energizing the control motor to reduce pump speed. When pressure falls below the maximum setting, the switch opens, halting further speed reduction. The pump continues to operate at constant speed equivalent to that obtained when the maximum pressure switch opened.

If system load increases, line pressure will fall below the predetermined minimum requirement. The pressure drop is sensed by the minimum pressure-stat which closes and causes the control motor to increase pump speed. When proper speed is reached for the new system load condition, further speed increase is curtailed and the pump runs at constant speed. With pressure sensing at both maximum and minimum conditions, the system can be made to operate at all times within the optimum pressure range.

The control sequence described in the foregoing paragraphs can be accomplished using electric, air or hydraulic switches and motors. Installations to date have utilized electrical control.

Location of the pressure-sensitive switches is critical and usually must be a compromise. In single-building installations having relatively small line losses, pressure switches can be located in the water piping adjacent to the pump discharge. With this arrangement, switches must be set to provide sufficient pressure to satisfy static pressure requirements at the highest point in the system and to overcome an average frictional loss. Location of the pressure-stats near the pump cuts control wiring to a minimum.

On large systems employing long runs of piping with relatively high frictional losses, the controls should be located at the highest, most distant point in the piping. With this arrangement, design pressure is maintained at all points throughout the system regardless of line losses. The switches must be located, however, on a riser which is adequately sized for its outlets.

Location of the pressure switch at the highest point creates a problem, however, because the system attempts to hold pressure constant only at the pressure switch location. During periods of high flow, then, when the "variable losses" resulting from flow are at their maximum, a building having the pressure switch installed at the highest point in the system will have, at its lowest tap, pressure which exceeds design allowances. Conversely, and for the same reason, if the switch is located in the basement, pressure at the highest tap will be short of design pressure during high-demand periods.

The best compromise solution for the pressure switch system is installation of the switches at the half-way point. This divides the "variable losses" between the highest and lowest taps and usually will result in a satisfactory system. It is important that the switches in this arrangement be enclosed in a "tamper-proof" box or panel to avoid tampering by unauthorized personnel.

Proportional Control

A very recent control arrangement which is rapidly gaining in favor for fluid drive house pump installations consists of a proportional control motor and a proportional controller. The motor and controller act somewhat as a servo system in that the controller is constantly influenced by the position of the motor which it controls.

As shown in Fig. 4, the proportional control system senses any pressure variation from the design point, and immediately begins to correct for this change. This differs from the pressure switch type of control in that pressure switches do not operate until the control pressure exceeds the 5-ft differential setting between the two switches. This permits the changing pressure to gain "momentum" before a correction is applied.

The proportional control motor contains a potentiometer which is directly connected to the motor output shaft. The output of this potentiometer is a voltage directly proportional to control motor position. This voltage is impressed upon a solenoid in the pressure controller, exerting a small force on the mechanism in a direction opposite to that caused by an increase in water pressure. Thus the control is able to anticipate the tendency to over-control, and the degree of correction tapers off as the design pressure is approached.

The overall effect of the proportional control system is a smoothness and consistency of control achieved by no other method to date. Under normal operating conditions, control of head within plus or minus 3 psi of design pressure can be maintained over the full range of operation. There is one point, however, which must be considered with this method of control. The controller must be located within 500 ft of the control motor. This is necessary to avoid excessive line losses which could occur in the feedback circuit from motor to control, resulting in false throttling action.

SPEED CONTROL

Figure 5 charts pump operating speed vs. scoop tube position. The minimum pump operating speed in this example (determined by the minimum anticipated system pressure requirement) is 1450 rpm; maximum speed is 1700 rpm. As shown on the curve, this range, which is the full range for pump operation in this application, is obtained within about 25% of the full range of stop-to-stop scoop tube travel.

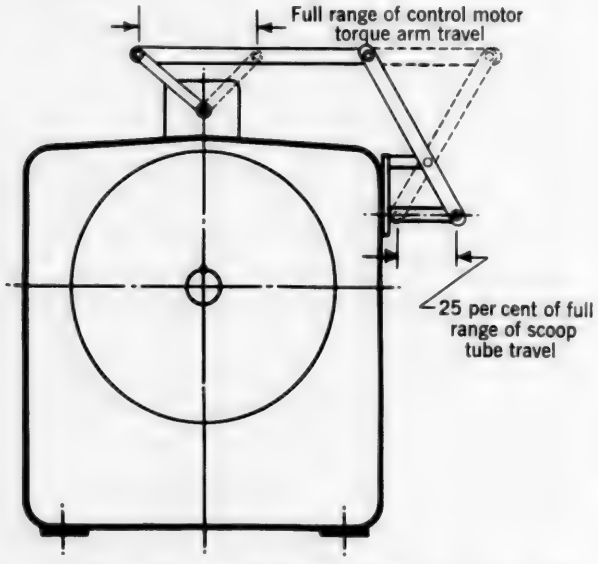


Fig. 6. Linkage between control motor and scoop tube control should be designed so that torque motor rotation through 90 degrees is required to move scoop tube control lever through "control range."

With a narrow control of this order, it is important that proper control motor and linkage be installed. Most control motors utilize a torque arm mounted on a rotating shaft to impart a linear motion for scoop tube adjustment. As indicated in Fig. 6, the linkage between control motor and scoop tube control should be designed so that full torque motor rotation (through 90 degrees) is required to move the fluid drive scoop tube control lever through the "control range" (about 25% of stop-to-stop movement). This is accomplished by varying the length of the control motor's torque arm. Ratio of fluid drive control arm length to torque arm length will vary with fluid drive size and job requirement; final adjustment of this ratio is made on the job.

Speed of response in a system utilizing an adjustable speed fluid drive must be tailored to meet the specific needs for each installation. Use of a relatively slow control motor is generally recommended. When a relatively slow control motor is used in combination with the proper control-arm-to-torque-arm linkage ratio, it acts as a control damper or snubber, preventing over-control.

In all residential and most commercial applications, load fluctuations in the water system occur gradually. In such systems, very satisfactory operation is achieved with a slow-response control motor.

MULTIPLE UNIT OPERATION

In a majority of house installations, more than one pump will be used. Control in multiple unit applications presents the double requirement of speed control and systematic pump sequencing to meet the widest variety of system demands at minimum power consumption.

Common Control Shaft

The control arrangement used to date for multiple unit installations is similar to that utilized in a Chicago Housing Authority system which has three pumps operating in parallel (Fig. 7). The pumps are rated at 650, 1350 and 2000 gpm. They are mounted with all shafts in line.

Running the full length of all three units is a common motor-operated control shaft to which is connected the speed control linkage for each fluid drive. With this arrangement, all scoop tubes are in the same relative position at the same time and are adjusted by a pair of common torque (control) motors. In this installation, the torque requirement of the shaft is such that two control motors, wired in parallel and mounted on the center fluid drive unit, operate the shaft. The torque motors react in response to signals from a pair of pressure-sensing switches.

Pumps are sequenced and brought on the line in relation to the delivery requirement of the system. A flow meter measures flow at the house pump discharge line; sequencing of pumps is accomplished through the motor starters according to the following schedule:

Flow (gpm)	650 gpm pump	1350 gpm pump	2000 gpm pump
0 to 600	on	off	off
600 to 1200	off	on	off
1200 to 1800	on	on	off
2000	off	off	on

The control used in the Chicago Housing Authority system incorporates a time delay which permits the unit

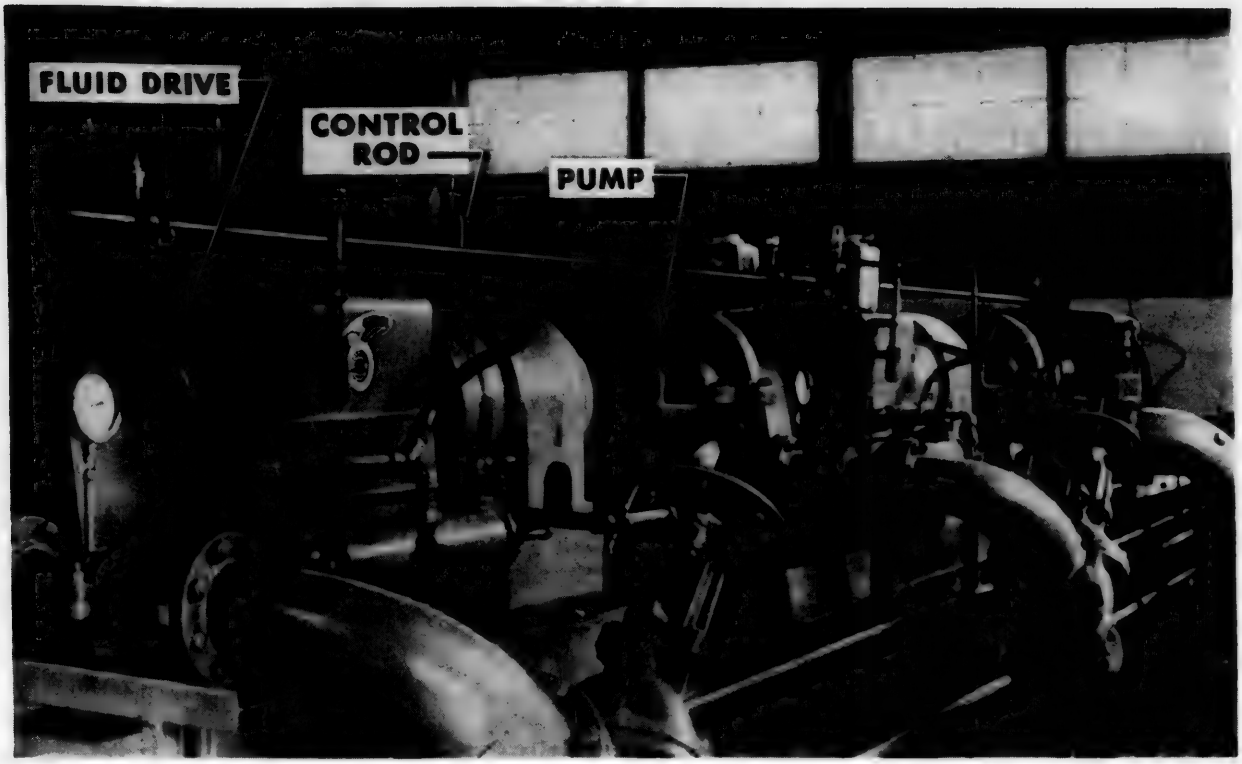


Fig. 7. Chicago Housing Authority system has three pumps operating in parallel and mounted in line. Two control motors, mounted on center fluid drive unit, satisfy torque requirements of common control shaft.

coming on the line to come up to speed and establish required pressure before the pump being removed from service is shut down.

Individual Control

Another method of control being given serious consideration involves the use of individual control sensing and actuating devices for each fluid drive. In this system, one pump is established as a base unit and is operated at all times. The second unit is sequenced by pressure-sensing switches set to operate at 3 to 5-ft less head than those connected with the base pump.

When the load increases beyond the capacity of the base pump, line pressure drops below the setting of the low-pressure switch for pump No. 2. The resulting signal causes torque motor No. 2 to adjust the scoop tube of the second fluid drive to proportionally increase the speed of pump No. 2.

Conversely, when the load decreases, the high pressure setting for the second pump is exceeded and the scoop tube in fluid drive No. 2 moves to zero pump speed position, halting operation of pump No. 2. Pump No. 1 continues to run and is controlled by signals from its own pressure-sensing switches.

To avoid constant operation of the No. 2 drive motor, a limit switch is installed on the scoop tube control lever or torque motor arm of the base pump. As the base pump reaches maximum operating speed, the limit switch trips to energize drive motor No. 2. Pump No. 2 is thus ready to deliver water when system demands exceed base pump capacity. When pressure rises and system requirements drop, the limit switch is tripped back to de-energize drive motor No. 2, which remains inoperative as long as the base pump is operating at reduced speeds.

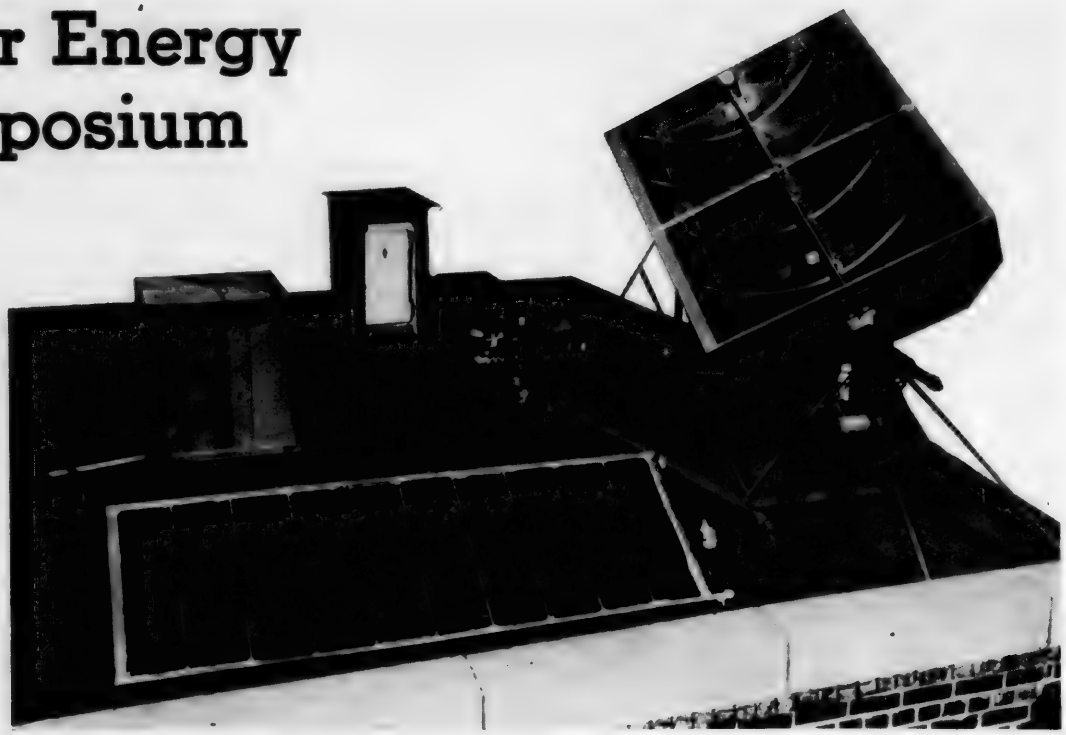
The major limitation of this individual control arrangement is the need for a 3 to 5-ft greater operating head range for each pump in the system. This is not critical in a two or three-pump system, but could be a significant drawback where a large number of pumps are to be used. In addition, this arrangement is not workable where pumps of different size are to be sequenced or where other than straight line sequencing is desired.

For example, using the individual control arrangement, the Chicago Housing Authority installation would require five 500-gpm units (using one as a standby). It would also require an operating pressure range of 12 to 20 ft of head greater than is required with the existing system. It provides the advantage, however, of control simplicity as compared with the relatively complex sequencing schedule required where the common scoop tube control mechanism is used.

At the present state of the art, best design practice favors the common shaft control arrangement of fluid drives and proportional control of system pressure.

Applications of the fluid drive-pump combination have been made in almost every industry where pumps are in use. This article has dealt specifically with systems which are controlled primarily by pressure, but it is equally simple to control the fluid drive with a liquid level, pressure-volume, or density sensing device. These sensing elements, properly selected and utilized with fluid drive and pump, can provide constant level in a vessel, constant pressure in a system, or can deliver constant volume or weight of fluid, using minimum horsepower. The equipment required is simple and provides reliable, maintenance-free and efficient service.

Solar Energy Symposium



The latest thinking in the various aspects of solar energy was presented recently at the 1959 Symposium on Solar Sciences, held at New York University under the joint sponsorship of the Association for Applied Solar Energy, New York University, and Stanford Research Institute.

Telling of their work, their goals, their successes, and even their troubles, were most of the top research scientists and engineers working toward the utilization of solar energy. Significance was seen in the fact that over half the participants represented either major corporations or governments; a few years ago a symposium of this sort would have been almost exclusively attended by research scientists representing universities.

Seven interesting technical sessions were held over a two-day period. They covered solar radiation measurement; solar collectors; water heating, space heating and cooling; solar distillation of sea water; solar refrigeration; thermoelectric, photoelectric and photochemical systems; and solar furnaces.

The third session, perhaps of most interest to readers of this publication, will be partially covered by two articles on the following pages.

Solar Space Cooling

R. CHUNG, G. O. G. LÖF, AND J. A. DUFFIE
University of Wisconsin
Madison, Wis.

Solar space cooling was discussed by Dr. John A. Duffie, of the Solar Energy Laboratory, University of Wisconsin, at the third technical session of the 1959 Symposium on Solar Sciences. His remarks were based on the following article which he co-authored and which originally appeared in *Chemical Engineering Progress.*

THE relation between space-cooling demands and solar energy supply in areas of high solar radiation has suggested the possibility of solar operation of absorption-cooling systems. In climates where space heating is needed, the same solar energy collector may be used for both winter heating and summer cooling. The flat-plate collectors suitable for use, however, have outputs which vary with time and intensity of incident solar radiation; therefore, direct substitution of the flat-plate solar collector for a conventional energy source for an absorption cooler is not feasible.

The costs of cooling by solar energy are not now competitive with the costs of cooling by conventional means in temperate climates. However, for the cost/ton-hr of cooling to be competitive with conventional systems, it was estimated that for coolers combined with solar heat-

ing systems it should cost no more than $2-7/sq ft of solar collector and its associated cooling system. Research and development on coolers and collectors should produce equipment costs within the allowable range. The allowable cost depends on the local price of energy from conventional sources, the equipment use factor, and the annual fixed charges. Thus, it appears that there could be combined operations of heating and cooling which would be competitive with conventional systems *in areas of high energy costs* in the near future. Solar cooling alone may be competitive in some foreign areas of large cooling demands and high-cost energy.

Solar Cooling Systems

Solar air-conditioners (or coolers) of several types have been proposed. The type of continuous cycle described here, Fig. 1, operates with steady flow of refrigerant through the components of the unit whenever heat is supplied from a solar collector, storage, or an auxiliary source. Other modifications of the collector or cooler may be used. The collector may serve as a refrigerant generator, or, the generator may be heated indirectly. The combination of generator and collector has the advantages of both reducing equipment requirement, and reducing the overall drop in temperature between the collector absorbing surface and the refrigerant-absorbent mixture in the generator.

Indirect heating of the generator makes it possible to interpose an energy storage unit between the collector and generator, allows more flexibility of operation of the collector, and permits easier use of the collector for winter space-heating operation. Indirect heating seems to be necessary if organic refrigerants or absorbents are used, because the equilibrium temperature of the absorbing surface in a well-designed collector, during periods of *no heat removal* from the collector, can be high enough (400-500 deg F) to cause decomposition of organic materials.

Energy storage, or thermal inertia, can be added to the system in several ways.

1. It can be interposed between the collector and generator in an indirectly heated system (hot-side storage) thereby smoothing out the energy supply to the generator, and permitting operation of the cooling system at, or near, design rates during periods of reduced radiation. The disadvantages of this are an increased temperature difference between the collector and generator, and heat loss from the storage unit.
2. Storage in another fluid (or solid) between the evaporator and the space to be cooled (cold-side storage) is also possible. This arrangement has the advantage of requiring only moderate temperature difference between storage and ambient. "Losses" to storage from the space to be cooled are not real losses if the storage unit is in that space, and the capacity requirements (Btu) are less* than for hot-side storage by a factor of the *coefficient of performance* (ratio of cooling obtained to heat input to the generator) of the cooler.
3. It should be possible, in principle, to store liquid refrigerant; but the quantities required are large compared to the normal amount of refrigerant needed in the system.
4. Thermal inertia in the building can provide some storage.

Most previous studies of solar refrigeration used movable focusing reflectors. With clear skies, these produced a nearly-constant energy-output rate throughout the day. However, well designed flat-plate collectors can operate in the temperature ranges required for absorption cooler generators. Their advantages of simpler construction, and suitability for use in space heating, indicate their potential utility for solar cooling applications.

The design of the solar-heated absorption cooler is

* Selection of hot-side or cold-side storage affects the design capacity of the cooling unit. If hot-side storage is used, the capacity of the cooling unit may be based entirely on the cooling requirements of the conditioned space. However, cold-side storage necessitates a cooling unit having a capacity sufficient to utilize all the solar heat at the time it is collected. The fluctuation in solar energy thus would require a larger cooling unit with cold-side storage than with hot-side storage.

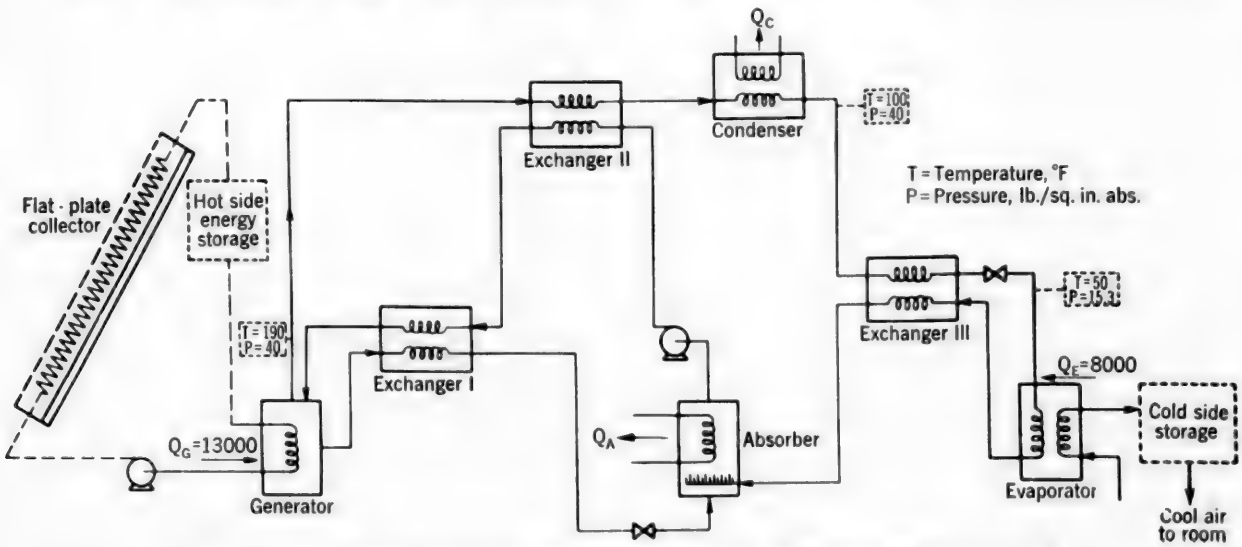


Fig. 1. Indirect-heated continuous solar absorption air conditioner. Performance calculations are based on this diagram.

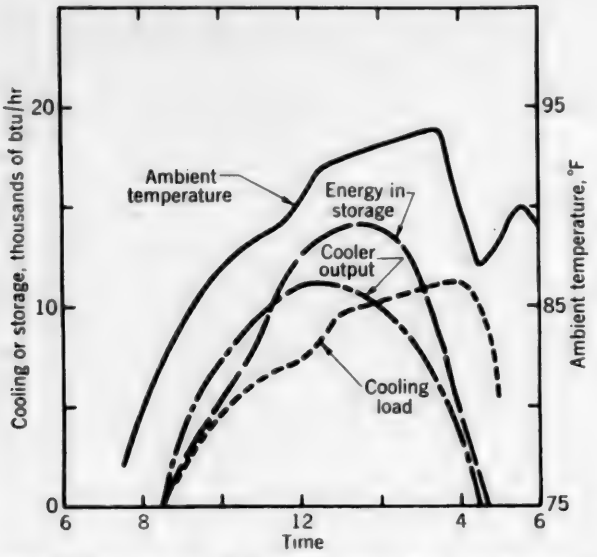


Fig. 2. Performance of solar cooler with cold-side storage for a day similar to the design day.

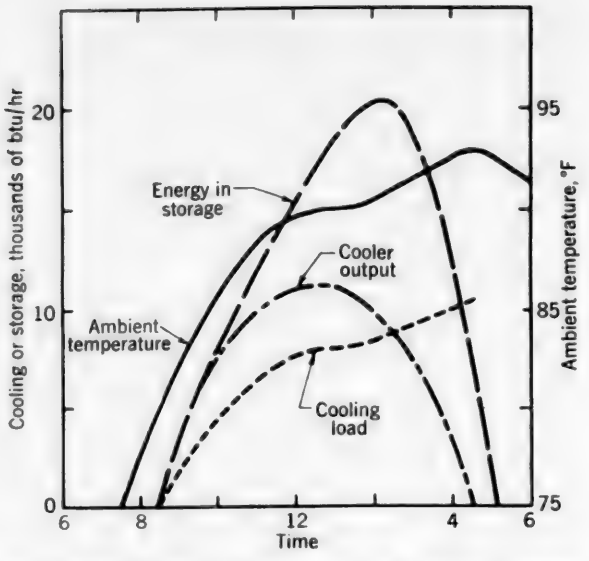


Fig. 3. Performance of solar cooler with cold-side storage for day of high storage requirements.

basically the same as that for cooling systems heated by fuels, but modified by the particular requirements and limitations imposed by the variable solar-energy source. In order that a satisfactory *solar collector performance coefficient* (energy transferred to heated fluid or to the generator per unit of incident solar energy) can be achieved, collector temperatures must be moderate, and heat transfer surface in the cooling unit must be designed for operation at temperature differences less than conventionally used. Cost considerations are affected by the nature of the operation. The addition of heat exchanger area to increase the cooler COP may be considerably cheaper than adding additional collector area to achieve the same increase in output. Selection of an absorbent-refrigerant system must be based on obtaining maximum COP with comparatively low generator temperatures necessitated by the conditions for efficient solar collector operation.

Design of a Solar Cooler

A solar cooler has been designed to provide cooling in part of a laboratory building in regular daily use through normal working hours, until about 5:00 p.m. An average cooling load of 8000 Btu/hr through an 8-hr working day, or 64,000 Btu/day, has been established as the design load. *Design* weather conditions were taken as average August clear-day solar radiation for Madison, Wis., and 90 deg F ambient temperature. Thus, the solar cooler must be capable of operating at a steady rate of 8000 Btu/hr (with hot-side storage), or at a variable rate up to approximately 1.5 times the nominal rate to produce an average of 8000 Btu/hr (with cold-side storage). The temperatures in the absorber and condenser are fixed at 100 deg by the maximum temperature of the cooling water available. The collector is most easily designed as a multiple of a basic unit size (fixed for this study at about 21 square feet). The units have copper sheets with integral tubes for water, coated with a selective black surface and covered with two or three layers of glass. Five of these units having a total area of 107 sq ft and tilted 35 degrees to the south should provide sufficient energy (when storage is used) to operate the cooling unit at design capacity for the day.

Figure 1 shows the principal temperatures and pressures for the unit operating at the nominal cooling capacity of 8000 Btu/hr. The generator and evaporator temperatures are based on compromises between good performance of the cooler (requiring high temperatures) and good performance of the solar heat exchanger and room cooler (requiring low temperatures). To supply the 8000 Btu of cooling, 13,000 Btu must be supplied to the generator. The sum of these two heat inputs to the system must be dissipated in the cooling water used in the absorber and condenser, or by other means. The system Freon 21-tetraethylene glycol-dimethyl ether is used.

The performance of the solar cooler, with operation of the collector as a constant-flow water heater, with a maximum water temperature of 210 deg, has been calculated on an hour-by-hour basis through the *design day*. The calculated total daily cooling capacities are 68,400 Btu for hot-side storage (at about 200 deg) and 71,400 Btu for cold-side storage (at 50 to 70 deg). The corresponding storage requirements are 19,000 Btu and 14,600 Btu. The hour-by-hour radiation and performance coefficients of both collector and cooler, with cold-side storage, are shown in Table 1.

Cold-side storage could be accomplished by placing the evaporator in the top of a water-tank storage unit, and withdrawing water from the bottom of the tank for comfort cooling. With the necessary temperature differences from evaporating refrigerant to water, and water to room air, the allowable rise in water temperature would be restricted to about 15 deg. Cold-side storage of 14,600 Btu would then require an insulated tank of about 115-gal capacity.

Calculated Performance

The *design* weather conditions were selected as representative of those under which a cooler would operate, but seldom are there days that approach the design conditions in all of their meteorological aspects. Figures 2

TABLE 1—DESIGN-DAY SOLAR RADIATION ON A COLLECTOR TILTED 35 DEGREES TO THE SOUTH, AND CALCULATED COLLECTOR, COOLER, AND OVERALL PERFORMANCE COEFFICIENTS FOR WATER HEATING OPERATION, COLD-SIDE STORAGE

Daylight Hours	Radiation, Btu per Hr per Sq Ft	Performance Coefficients		
		Collector	Cooler	Overall
11-12, 12-1	340	0.52	0.66	0.34
10-11, 1-2	310	0.49	0.66	0.32
9-10, 2-3	250	0.47	0.63	0.30
8- 9, 3-4	190	0.38	0.56	0.21
Overall	—	0.43	0.64	0.28

and 3 show the calculated performance of the solar cooler for two days of substantial cooling demand and illustrate the effects of combinations of meteorological conditions on capacity and storage requirements. Shown are the hourly changes of ambient temperature, cooling loads, cooler output and amount of useful storage, for water heating operation using cold-side storage. Hour-by-hour calculations of collector and cooler performance are based on the ambient temperature and hourly radiation data from Madison Weather Bureau records for each of the days. Cooling loads are taken as proportional to the difference between ambient temperature and 80 deg.

Calculated performance for a day which approximates the conditions assumed in the design is shown in Fig. 2. The ambient temperature is below 90 deg in the morning and slightly above 90 deg in the afternoon. Compared with design conditions, this results in reduced cooling load in the morning, and increased cooling load in the afternoon. The design storage capacity of 14,600 Btu is adequate to handle the 14,100 Btu requirement for this day. The total daily cooling load (to 5:00 p.m.) is 66,000 Btu; the cooler output is 64,000 Btu. Figure 3 shows a similar situation, but with more pronounced deviation from the 90 deg *design* ambient temperature. The increased loads on the system in the afternoon indicate a storage requirement of 20,300 Btu. The total day's cooling load is 61,000 Btu, while the cooling availability is 63,000 Btu. Other examples could illustrate days of excess or inadequate cooling capacity. A need for nighttime cooling would substantially increase collector and storage requirements.

Conclusions

The solar radiation data and calculation of solar heat collection in this design study are based on Madison conditions. However, heat recovery is approximately that which would be encountered on clear days on a collector of optimum orientation at most locations in the United States. The considerations outlined in this design study, and the approximate sizing of the equipment to produce a unit of cooling, are thus applicable to other locations. Assumptions and approximations concerning collector performance represent practical conditions which can be attained. While the operating conditions noted were selected after extensive study, a detailed optimization of the solar cooling system to minimize the total cost of cooling has not as yet been completed. The ultimate choice of a cycle and type of operation, method of storage, and the sizing of the components, should be made on the basis of costs of components, of energy from conventional sources, and of a detailed study of the meteorological conditions in the area of application. A further important consideration is the relative magnitude of winter heating requirements and summer cooling requirements for a system which uses the collector and storage facilities for both operations, as the collector and storage capacities may be fixed by the requirements of either of the operations. In most space heating applications, an auxiliary (conventional) energy source will be required, and this source may also be used as an auxiliary energy supply for the cooling system. If 100% availability of cooling is required, an auxiliary source of heat energy must be provided in most climates to operate the cooler during prolonged cloudy periods.

Under the conditions assumed in this study, an overall COP of about ¼ is indicated (four Btu radiation incident on the collector will produce about one Btu of cooling, under good radiation conditions). Thus the collector area requirements indicated by this study are about 160 sq ft/nominal ton of cooling capacity for an 8-hr day (or 480 sq ft/ton-day of cooling) for a well designed collector with optimum orientation, a cooler with high coefficient of performance, and typical clear day radiation.

Solar Water Heating

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Present practices and new directions in solar water heating were discussed by Professor Erich A. Farber, of the College of Engineering, University of Florida, at the third technical session of the 1959 Symposium on Solar Sciences. He concluded with a few remarks on solar space heating.

THIS paper will briefly describe methods used for solar water heating—the only commercially available application of solar energy in the United States at this time. First, present practices are briefly described, and then, newer and better designs. Solar-heated water has found applications in domestic hot water supply, in restaurants,

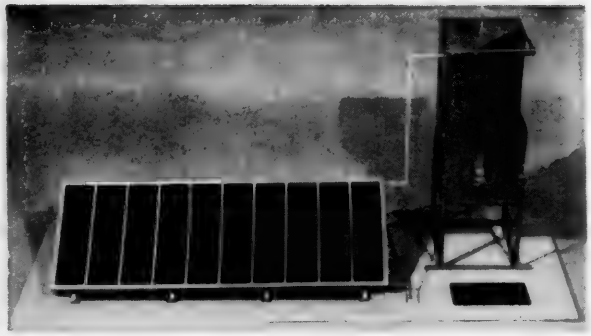

Fig. 1. Commercially available solar water heating system.

hot water for space heating, and swimming pool heating. A similar method can also be used for air heating and is described at the end of the paper.

Solar Water Heating

Many of these remarks pertaining to Florida are actually much more general, and can be modified for other areas. In Florida, solar water heating is well established with a number of industries specializing in the manufacture and installation of the "standard Florida design" as it is found today. Figure 1 shows such a heater consisting of an absorber and a storage tank. The absorber consists of a copper sheet with copper tubes soldered to it, formed into a sinusoidal pattern. This sheet and tube combination is then placed into a sheet metal box with insulation under the actual heating element and with a single glass cover over the top.

The water heated by such an arrangement, which for a single family dwelling is usually 4 x 12 ft, is then stored in an insulated tank from which it can be drawn as needed. The tank is normally found higher than the absorber since this allows free or natural circulation between the absorber and the tank, and does not require a pump. The tank size is usually figured allowing about 20 gallons of hot water per person per day.

The best orientation for the absorber or heat collector is facing south at an inclination with the horizontal equal to the local latitude plus 10 degrees. This gives more efficient operation during the shorter days in the winter. For such an installation in Florida an average conversion efficiency of about 70% can be expected. Some typical actual installations are shown in Fig. 2, 3 and 4. Some of the storage tanks in these installations appear as a false chimney protruding through the roof.

These standard solar hot water systems have two serious limitations:

(A) The maximum water temperature is below 200 deg F and decreases with an increase of the water quantity needed.

(B) In freezing weather the absorber has to be protected either by heating or by draining, since otherwise serious damage will result.

Much of the more recent work has been connected with attempts to overcome these difficulties. Several methods have been devised and investigated.

To overcome the difficulties pointed out under (A), three main changes have been made:

1. More glass layers have been added, decreasing the heat losses from the front of the absorber and thus increasing the temperatures attainable. By this method, however, the actual amount of heat reaching the absorber element is decreased since the transmissivity of the glazing arrangement is reduced.

2. A flat plate absorber was coupled with a concentrating absorber as shown in photo on the cover of this issue. Temperatures of over 500 deg were obtained with this arrangement. On cloudy days when solar concentration was not possible, the concentrating absorber was bypassed and only the flat plate absorber used.

3. Since the arrangement shown in cover photo is relatively complicated, requiring a tracking mechanism, and expensive, an attempt has been made to accomplish essentially the same results with a much less expensive system. Figure 5 shows such a high temperature absorber which consists of horizontal parabolic troughs with the pipe running through them at the focal line. This high temperature absorber was set up facing south, inclined with the horizontal at an angle equal to the local latitude plus 10 degrees. The maximum temperatures obtained were less than those with the arrangement described under 2, but this system was much less expensive and once set up needed no further attention.

To overcome the difficulty of freezing damage as

Fig. 2. Battery of roof-mounted flat plate collectors.

Fig. 3. Flat plate collector is built into this roof.

Fig. 4. Flat plate collector doubles as sun shade.

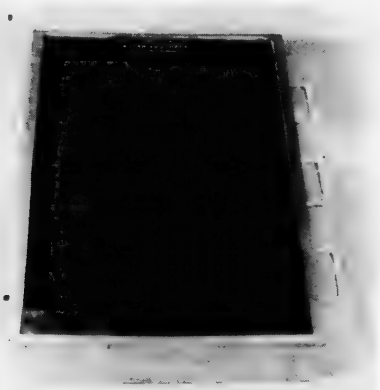

Fig. 5. (Left) Inexpensive high-temperature absorber.

Fig. 6. (Right) Absorber for solar air heating.

pointed out under (B), "dual circulation systems" were designed using a closed primary loop operating at atmospheric pressure. These arrangements have two advantages:

1. The primary or energy absorbing circuit could be operated with any fluid under any pressure; atmospheric was naturally the most convenient pressure. Water was used with antifreeze added in the primary circuit, and the absorber could thus not be damaged by freezing temperatures. There were two design arrangements. One had a heating coil in the tank, and the primary hot fluid circulated through this coil transferred heat to the water in the tank. The other design was a double-walled tank with a very thin outer shell which formed part of the primary circuit; heat was transferred to the water in the tank through the cylinder wall. This latter construction was very simple and inexpensive.

2. Having a primary circuit which operates at atmospheric pressure makes it possible to have an absorber construction utilizing very thin sheetmetal, since the absorber does not have to have much structural strength. Estimates indicate that the savings obtainable in the absorber construction are enough to pay for the double-walled tank arrangement.

Some of these improved designs will probably become available in the future as other methods of producing hot water become more expensive, and as the cost of the solar water heaters is reduced through use of better and cheaper materials such as plastics, etc. It also is much more economical to incorporate a solar hot water system into an original building than to install one later. The absorber could, for instance, replace a section of the roof which would otherwise be needed.

Solar Space Heating

For the purpose of space heating, hot water could be used in the conventional manner and the hot water supplied as it is for other purposes. So the solar collecting and storage part would not differ except possibly in size.

If air is used for heating purposes, then it can be obtained from a solar air heater. Only one design with small variations has been investigated here. It consists of a wooden box with overlapping aluminum sheets spaced about 1 inch apart with ⅓ of each plate exposed to the sun. The box was covered with one layer of glass (and for comparison, later, with a number of different plastic sheets). The heat reaching the aluminum plates, which were painted to present as good an absorbing surface as possible, was then distributed by conduction throughout the plate. The air streaming over the plates and between them was heated by convection. One small absorber of this type is shown in Fig. 6. Both free and forced convection and circulation were used in the tests, and efficiencies comparable with absorbers of the hot water systems were obtained.

Ions in Air Found to Affect Health

The small electrical charges found naturally in the air have physiological effects important to health, according to a recent report to the American College of Chest Physicians.

Two years of research on rodent, monkey and man has shown that negative ions in the air have a stimulating effect on the respiratory system, while an excess of positive ions is harmful, according to the report read by John C. Beckett, an electrical engineer.

This is considered potentially important to both medicine and public health because several common attributes of civilization tend to reduce the natural negative charges in the air and increase the positive charges. These factors include smog and other air pollution, common heating and air conditioning apparatus and, under most circumstances, smoking, Mr. Beckett reported.

The physiologically important ions are positively-charged carbon dioxide and negatively-charged oxygen. These are found to exert a profound effect on the cilia, or hairlike projections, lining the bronchial tubes, trachea or windpipe, and nasal passages.

The cilia propel sticky mucus on the air passage linings toward the mouth and nose, away from the lungs. The mucus serves as a trap for foreign particles, such as dust and pollens. Research at the University of California showed that negative ions caused the cilia to speed their clearing action, while positive ions slowed their action or even stopped it.

Safeguarding Water Supplies for Hospitals

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Water systems for hospitals must be carefully designed to provide a constant water service, even under adverse conditions, and designed to prevent water contamination due to backflow through outlets and fixtures. Article explains how quantity and quality of water supply can be protected.

TWO prime factors must be considered in supplying water to a hospital. They are quantity and quality. When a hospital is constructed in a rural community which does not have a central water supply, it is necessary to obtain water from wells or surface supplies. Water from this source must be treated and stored on the hospital property and a competent person put in charge to test the water regularly for B-coli. The presence of such bacteria is an index of a contaminated water supply. Water treatment insures quality of a supply and the storage is a guarantee of the desired quantity.

TABLE I—REQUIRED PRESSURE FOR HOSPITAL FIXTURES

Fixture	Pressure Required, Psi
Floor outlet water closets	10
Wall hung water closets	15
Sanitizers	20
Bed pan washers	10
Flushing rim sinks	10
Electric water coolers	15-20*
Sink, lavatories, etc.	8

* Minimum pressure, 15; recommended pressure, 20

In an urban community, water is supplied by either municipal and/or private water companies. These operators distribute the potable water through the street mains to the hospital; they only insure the potability of the entering water and not the quantity, as this is the function of the engineer in charge of the hospital design. It is also the function of this engineer to plan the water distribution system so as to prevent contamination of the potable water supply through back siphonage or cross connections with non-potable or contaminated water.

Quantity

When discussing quantity, reference must be made to pressure, peak hourly draw and peak gallon per minute draw. Water pressure is important as this is the force that drives water through the piping in the building. It must be checked or verified to ascertain whether or not the entire hospital can be supplied from the street supply and still have satisfactory residuals to operate the various hospital fixtures. Required water pressure to operate various hospital fixtures are listed in Table 1.

Importance of Residual Pressure

A flow test should be performed to obtain the residual pressures in the nearby city mains when water is being drawn off at a rate of 500 to 1000 gpm. This information is important for during a conflagration there are such heavy water flows from city water mains that water pressures in services drop sharply. The residual pressure at such times must be sufficient to supply all the hospital fixtures. This residual pressure helps the engineer to determine whether the water supply is satisfactory.

The peak hourly demand is also important and this figure is used in sizing the house or storage tank whenever one is required. There should be a sufficient quantity of water available to provide the hospital with a minimum of a 30-minute supply in the event of a temporary failure of the prime or street supply. This was discussed in a previous article.* To insure a continuous street supply, separate connections to two independent street mains, Fig. 1, should be installed. Each main

* Roof and Zone Tanks for Multi-story Buildings, by George R. Jerus, *Air Conditioning, Heating and Ventilating*, March, 1958, pp 67-82.

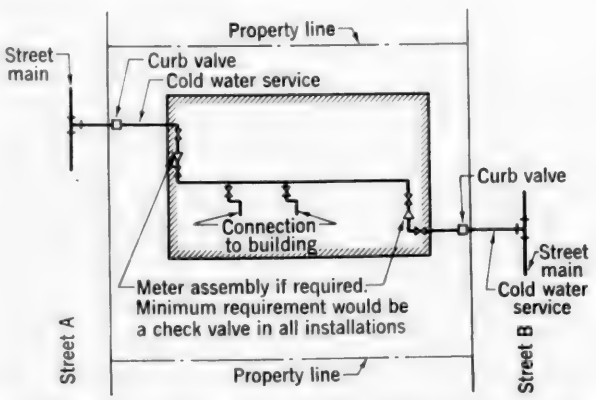


Fig. 1. Connections are made to two separate water mains.

should be full required size to give complete breakdown service in case of pressure failure or break in one main.

Booster Service

In the event that the pressure available is insufficient to supply adequate water at the top floor, the engineer must design the water supply system with either booster pumps on the cold water services, a house tank above the highest floor with pumps to fill the tanks, or a pressure tank with booster pumps. Booster pumps in the street supplies should only be used in installations where the pressure is normally sufficient to adequately supply the building, but where for short and infrequent periods, the pressure might drop below the required minimum. The booster pump should have a pressure relief valve installed along with a time switch to provide a minimum running time once the pump is started by the pressure switch. The pump should run for approximately four to five minutes which is the recommended time to bring the motor up to proper operating temperature; the relief valve functions should the desired pressure be reached before the end of the required minimum operating time. Any pump used to provide water in a hospital should be put on the hospital's emergency power circuits to insure a continuous water supply during power failures.

Supply Lines

The individual services of the hospital's water supply should be cross-connected. However, they must be provided with check valves to eliminate the possibility of one street service feeding through the hospital main into the other street or to preclude the possibility of draining the hospital piping in the event a fire department pumper connects to a hydrant adjacent to the hospital.

Distribution headers, risers and branches must be adequately sized to maintain the proper residual pressures at the remotest fixtures and thereby insure operation during peak gallon per minute draw. Risers and branches must be valved where they connect to the supply pipe so that minor repairs and alterations do not disrupt large segments of the hospital. Proper valving localizes such disruptions to small areas. By providing stops at each fixture, the flow can be adjusted at the fixture and simple washer repairs would not put rooms out of operation that are served by such fixtures. Only the individual fixture is involved. All this is in reference to maintaining the entire cold water supply. In addition, consideration must be given to the continued maintenance of the hot water supply. This can be accomplished by installing duplex heaters on specific service or in the event that the hospital has a laundry and kitchen, three heaters can be used; one each for domestic hot water and for the kitchens and laundry the third is installed for use during a breakdown of one of the others. A diagrammatic piping arrangement is shown in Fig. 2.

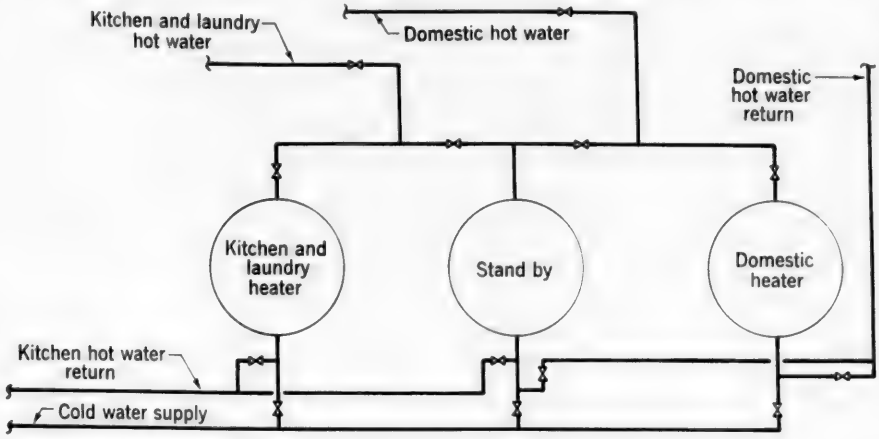


Fig. 2. Three water heaters are installed to provide continuous service for domestic, and kitchen and laundry needs.

Each hot water system should be provided with individual hot water circulating pumps.

Quality

Once the potable supply enters the building, there is the problem of maintaining water quality. All direct cross connections between a potable and non-potable supply should be avoided, and wherever make-up water for the non-potable supply is required, the connection should be through an open sight or funnel with a 1-inch air gap provided to divorce both systems. However, in some instances, it is necessary to make some connections that may be considered to be a cross connection or submerged inlets (bed pan washers, hose bibbs, etc.). These connections must be provided with a check valve and vacuum breaker to prevent back-siphonage of the contaminated water into the potable system.

Because the water aspirator was one source of contamination in hospitals, most water companies and health departments have outlawed their use and have insisted

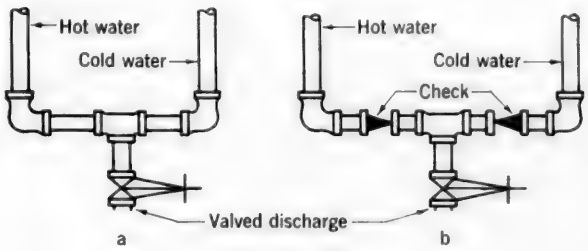


Fig. 3. Hot water connections.

upon mechanical vacuum pumps regardless of how the water is to be supplied to the aspirator, unless it is a completely divorced system. Most doctors prefer the water aspirator because better regulation of the vacuum can be maintained at the specific location.

Many communities have insisted upon separate water systems to the mortuary tables; the cold water must fill a reservoir tank through an open connection and water for the autopsy room would be supplied from this tank. When this is a requirement, the tank must be located high enough above the autopsy room to provide adequate pressure. When these rooms are served through pressure supplies from the potable water mains, the branches must then be properly sized, double checked and provided with a vacuum breaker.

Quality, in the sense of water temperature, is maintained through the use of thermostatic mixing valves. These valves reduce the temperature of the hot water through the addition of cold water and, therefore, prevent scalding. However, if the discharge of a mixing faucet has a shut-off valve as in Fig. 3a, then the hot and cold water supplies must be provided with check valves as shown in Fig. 3b. This will prevent hot or cold water from bypassing into the opposite lines, particularly where the pressures on the systems are not the same, i.e.: cold water from the street pressure and hot water supplied from a house tank. The arrangement shown would be applicable at hot and cold water bed pan washers, pot sinks with hose sprays, barbers sinks and similar fixtures.

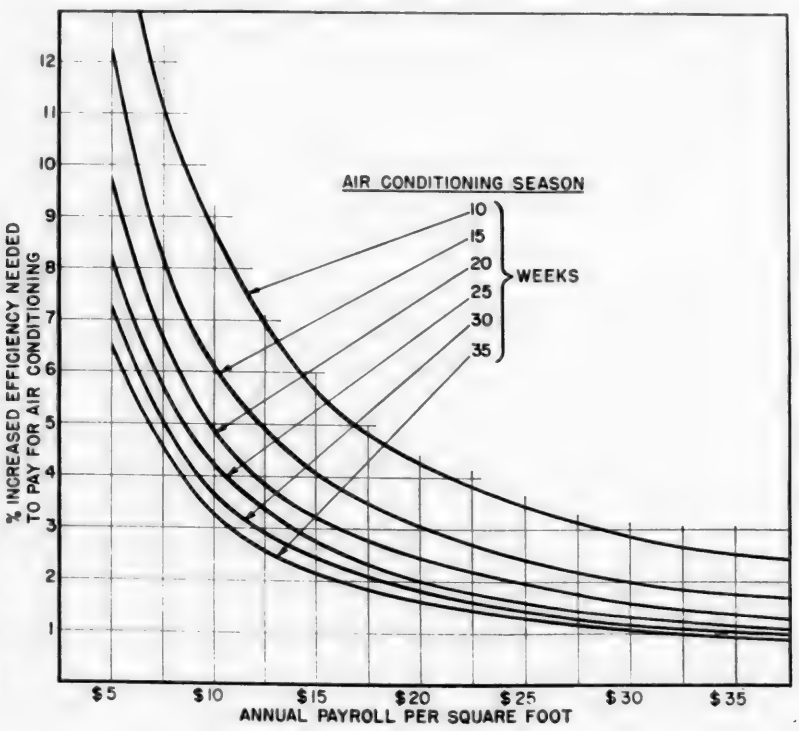
One of the new concepts in hospital treatment is radioactive isotopes. If this field continues to expand, and it is my belief that it will, then it may be necessary to supply these rooms with individual and dead end supplies so as to eliminate the possibility of contaminating the water supply through radioactive substances.

When Does Industrial Air Conditioning Start Paying a Profit?

A method developed by Typhoon Air Conditioning Co., division of Hupp Corp., will tell how large an increase in worker efficiency is needed before an investment in air conditioning will start paying a profit in an industrial plant. The method is based on the ratio between the cost of air conditioning and payroll costs.

Although air conditioning offers many advantages that cannot be measured by payroll costs, most companies must base a decision to air condition on increased worker efficiency. Less absenteeism, less turnover, improved employee relations, improved quality and fewer rejects. and, in new buildings, elimination of windows if desired, are advantages worth considering; however, the final decision usually depends upon lower payroll costs per unit of output.

How much does air conditioning increase efficiency? Typical figures developed by independent organizations show an increase of 22 to 28% in general manufacturing, 35% among "white collar" workers, 24% in stenographic pools, 29% in hosiery manufacturing, and 51% in drafting rooms. Because these figures seem incredibly high, the Typhoon method was developed to find the minimum increase needed to pay for air conditioning. Curves based on the method, are shown below; they give a figure of sufficient accuracy to help arrive at a preliminary decision.



Curves show efficiency increase required to pay for air conditioning at varying payroll costs per square foot and varying lengths of air conditioning season. Comparisons show that variances in payroll costs per square foot are more important than climatic differences in determining value of air conditioning. Installation costs, interest on investment, insurance and taxes are calculated at 15c per square foot per season, and power at 1.5c per kwh.

Pipe Friction Tables

For 60-Degree, 180-Degree, and 300-Degree Water Flowing in Schedule 40 Steel Pipe

RICHARD L. KORAL
Associate Editor

Herein are presented friction loss tables designed specifically for use by heating and plumbing engineers. Values of flow in gallons per minute, cubic feet per second, and pounds per hour; of velocity; and of friction loss per 100 ft of pipe in feet of 60-deg F water for water at 60-, 180-, and 300 deg, were computed and arranged by the author for convenient sizing of cold water, domestic hot water, conventional hot water heating, and high temperature water systems. Although additional tables will be published in subsequent issues of this publication, the procedure for calculation of supplemental data, consistent with the tabular values herein, is given.

IN 1944, Prof. Lewis F. Moody embodied the then accepted conclusions of researchers in fluid mechanics on the subject of the friction factors for computing loss of head in pipes. His paper, Friction Factors for Pipe Flow, presented at the semi-annual meeting of The American Society of Mechanical Engineers, contained the Moody Chart which has gained an ever widening stature with working engineers, who find his chart a rapid and convenient tool in sizing piping systems.

Friction Factor

Use of the Moody Chart has certain drawbacks, however. The chart curves give friction factor as a function of Reynolds Number plotted on logarithmic coordinates, and curved lines of relative roughness, necessitating two difficult interpolations. In 1947, Prof. Moody presented a formula for friction factor in terms of the same variables, which agrees with the most theoretically correct formulation of the friction factor within ± 5% for all values of the variables within the scope of these tables. The Moody formula is:

$$f = 0.0055\ [1 + (20{,}000\ e/D + 10^6/N_R)^{1/3}]$$

where f = friction factor, dimensionless,
e/D = relative roughness, dimensionless,
e = absolute roughness, ft,
D = inside diameter of pipe, ft,
N_R = Reynolds Number = VD/ν
V = mean fluid velocity, fps, and
ν = coefficient of kinematic viscosity of the fluid, sq ft per sec; ν = 0.00001216 for 60-deg water, 0.00000385 for 180-deg water, and 0.00000218 for 300-deg water.

Friction Loss

In computing these tables, values of f from the above equation are substituted in the familiar Darcy formula for pipe friction loss,

$$H_L = f\ (L/D)\ (V^2/2g)$$

where H_L = pipe friction loss in feet of fluid flowing,
L = length of pipe, ft, and
g = gravitational constant, 32.2

Pipe length L was taken at 100, so that H_L reads in feet per 100 ft of pipe. In the case of H_L values for 180- and 300-deg water, feet of fluid is multiplied by the ratio of the densities of water at the elevated temperature to that of the density of 60-deg water, so that all H_L values read in feet of 60-deg water, which is common practice.

The resulting tabular values of friction loss are for new, clean steel pipe, with absolute roughness equal to 0.00015 ft, an approximation correct to within ± 5%.

FRICTION LOSS IN ⅜-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft
0.6	0.00134	1.01	300	1.72	291	1.33	276	1.17
0.8	0.00178	1.34	400	2.88	389	2.28	368	2.02
1.0	0.00223	1.68	500	4.29	486	3.46	460	3.09
1.5	0.00334	2.52	750	8.92	729	7.44	690	6.74
2.0	0.00446	3.36	1,000	15.2	972	12.9	919	11.8
2.5	0.00557	4.20	1,250	22.9	1,215	19.8	1,149	18.2
3.0	0.00668	5.04	1,500	32.2	1,457	28.3	1,379	26.1
3.5	0.00780	5.88	1,750	43.0	1,700	38.2	1,609	35.4
4.0	0.00891	6.72	2,000	55.3	1,943	49.5	1,839	46.0
4.5	0.0100	7.56	2,250	69.2	2,186	62.5	2,069	58.1
5.0	0.0111	8.40	2,500	84.8	2,429	76.9	2,298	71.7
6.0	0.0134	10.1	3,000	120	2,915	110	2,758	102
7.0	0.0156	11.8	3,500	162	3,401	149	3,218	139
8.0	0.0178	13.4	4,000	209	3,887	194	3,677	182
9.0	0.0201	15.1	4,500	263	4,372	245	4,137	230
10.0	0.0223	16.8	5,000	323	4,858	302	4,597	283

FRICTION LOSS IN ½-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft
1.0	0.00223	1.06	500	1.38	486	1.08	460	0.946
1.5	0.00334	1.58	750	2.86	729	2.30	690	2.05
2.0	0.00446	2.11	1,000	4.81	972	3.95	919	3.56
2.5	0.00557	2.64	1,250	7.22	1,215	6.05	1,149	5.49
3.0	0.00668	3.17	1,500	10.1	1,457	8.58	1,379	7.83
3.5	0.00780	3.70	1,750	13.4	1,700	11.5	1,609	10.6
4.0	0.00891	4.22	2,000	17.2	1,943	14.9	1,839	13.7
4.5	0.0100	4.75	2,250	21.4	2,186	18.8	2,069	17.3
5.0	0.0111	5.28	2,500	26.1	2,429	23.0	2,298	21.3
6.0	0.0134	6.34	3,000	36.8	2,915	32.9	2,758	30.5
7.0	0.0156	7.39	3,500	49.4	3,401	44.5	3,218	41.4
8.0	0.0178	8.45	4,000	63.2	3,887	57.4	3,677	53.4
9.0	0.0201	9.50	4,500	79.6	4,372	72.7	4,137	67.8
10.0	0.0223	10.6	5,000	97.5	4,858	89.6	4,597	83.7
11.0	0.0245	11.6	5,500	118	5,344	108	5,056	101
12.0	0.0267	12.7	6,000	139	5,830	128	5,516	120
13.0	0.0290	13.7	6,500	162	6,316	151	5,976	141
14.0	0.0312	14.8	7,000	188	6,801	175	6,435	164
15.0	0.0334	15.8	7,500	214	7,287	200	6,895	188

FRICTION LOSS IN ¾-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft	Flow, Lb per Hr	Pressure Loss, Ft Per 100 Ft
1.0	0.00223	0.602	500	0.358	486	0.269	460	0.231
1.5	0.00334	0.903	750	0.734	729	0.566	690	0.494
2.0	0.00446	1.20	1,000	1.22	972	0.960	919	0.848
2.5	0.00557	1.50	1,250	1.82	1,215	1.46	1,149	1.30
3.0	0.00668	1.81	1,500	2.51	1,457	2.05	1,379	1.84
3.5	0.00780	2.11	1,750	3.32	1,700	2.75	1,609	2.48
4.0	0.00891	2.41	2,000	4.25	1,943	3.54	1,839	3.21
4.5	0.0100	2.71	2,250	5.27	2,186	4.44	2,069	4.04
5.0	0.0111	3.01	2,500	6.40	2,429	5.44	2,298	4.96
6.0	0.0134	3.61	3,000	8.98	2,915	7.73	2,758	7.09
7.0	0.0156	4.21	3,500	12.0	3,401	10.4	3,218	9.57
8.0	0.0178	4.81	4,000	15.3	3,887	13.5	3,677	12.4
9.0	0.0201	5.42	4,500	19.1	4,372	16.9	4,137	15.7
10.0	0.0223	6.02	5,000	23.3	4,858	20.8	4,597	19.3
11.0	0.0245	6.62	5,500	28.0	5,344	25.1	5,056	23.3
12.0	0.0267	7.22	6,000	32.5	5,830	29.7	5,516	27.6
13.0	0.0290	7.82	6,500	38.4	6,316	34.8	5,976	32.4
14.0	0.0312	8.42	7,000	44.3	6,801	40.1	6,435	37.4
15.0	0.0334	9.03	7,500	50.7	7,287	46.2	6,895	43.1
16.0	0.0356	9.63	8,000	57.2	7,773	52.3	7,355	48.8
17.0	0.0379	10.2	8,500	64.4	8,259	59.1	7,814	55.2
18.0	0.0401	10.8	9,000	71.6	8,745	65.9	8,274	61.6
19.0	0.0423	11.4	9,500	79.6	9,231	73.4	8,734	68.6
20.0	0.0446	12.0	10,000	87.9	9,716	81.2	9,193	76.0
22.0	0.0490	13.2	11,000	106	10,688	97.9	10,113	91.8
24.0	0.0535	14.4	12,000	125	11,660	117	11,032	109
26.0	0.0579	15.6	13,000	146	12,631	139	11,951	128
28.0	0.0624	16.8	14,000	169	13,602	158	12,871	148
30.0	0.0668	18.1	15,000	193	14,575	181	13,790	170

Because the absolute roughness of wrought iron pipe is the same, these tables apply equally to wrought iron pipe of the same inside diameter.

Old Pipe

As pipe grows old in service, its interior walls may roughen considerably. As can be seen from the Moody equation, an increase of e will increase H_L. Thus, the piping designer must supply a correction factor to the friction loss values in the table, based upon his judgment of what the condition of the pipe will be during its life. *There is no one factor that applies to all "old pipes"*. Well-deaerated high temperature water, for instance, has little corrosive effect on steel pipe, even after many years of HTW system operation. On the other hand, raw cold (or hot) water will, in many instances, materially corrode non-alloy steel pipe, increasing its roughness.

In the case of the smaller pipe, accumulation of corrosion products and scale deposits may significantly reduce its inside diameter. The resultant increase in velocity for the same flow rate increases the friction drop.

Supplemental Data

Users of the tables will find helpful, also, flow rates in pounds (or thousands of pounds) per hour for each temperature water. Not only does this arrangement present a handy conversion table, but, for heating engineering, the weight flow rate enables rapid calculation of heat transfer, bearing in mind that the specific heat of water is approximately unity for temperatures of 60 and 180 deg, and 1.03 Btu

FRICTION LOSS IN 1-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft
1	0.00267	0.371	500	0.113	486	0.0830	460	0.0700
2	0.00446	0.742	1,000	0.381	972	0.290	919	0.252
3	0.00668	1.11	1,500	0.778	1,457	0.612	1,379	0.540
4	0.00891	1.48	2,000	1.30	1,943	1.05	1,839	0.936
5	0.0111	1.86	2,500	1.94	2,429	1.59	2,298	1.43
6	0.0134	2.23	3,000	2.71	2,915	2.25	2,758	2.04
7	0.0156	2.60	3,500	3.59	3,401	3.03	3,218	2.75
8	0.0178	2.97	4,000	4.59	3,887	4.08	3,677	3.56
9	0.0201	3.34	4,500	5.70	4,372	4.89	4,137	4.48
10	0.0223	3.71	5,000	6.94	4,858	6.00	4,597	5.51
12	0.0267	4.45	6,000	9.76	5,830	8.54	5,516	7.87
14	0.0312	5.20	7,000	13.0	6,801	11.6	6,435	10.7
16	0.0356	5.94	8,000	16.8	7,773	15.0	7,355	13.9
18	0.0401	6.68	9,000	21.0	8,745	18.9	8,274	17.5
20	0.0446	7.42	10,000	25.7	9,716	23.2	9,193	21.6
22	0.0490	8.17	11,000	30.8	10,688	28.1	10,113	26.1
24	0.0535	8.91	12,000	36.2	11,660	33.1	11,032	30.9
26	0.0579	9.65	13,000	42.5	12,631	38.9	11,951	36.3
28	0.0624	10.4	14,000	48.9	13,603	45.0	12,871	42.0
30	0.0668	11.1	15,000	55.9	14,575	51.6	13,790	48.2
32	0.0713	11.9	16,000	63.2	15,546	58.4	14,709	54.7
34	0.0758	12.6	17,000	71.3	16,518	66.1	15,629	61.9
36	0.0802	13.4	18,000	79.6	17,490	74.0	16,548	69.3
38	0.0847	14.1	19,000	88.2	18,461	82.1	17,467	77.0
40	0.0891	14.8	20,000	97.7	19,433	91.1	18,387	85.4
42	0.0936	15.6	21,000	107	20,404	100	19,306	94.1
44	0.0980	16.3	22,000	118	21,376	110	20,225	103
46	0.102	17.1	23,000	128	22,348	120	21,145	113
48	0.107	17.8	24,000	139	23,319	130	22,064	122
50	0.111	18.6	25,000	151	24,291	141	22,984	133
55	0.123	20.4	27,500	182	26,720	171	25,282	161
60	0.134	22.3	30,000	215	29,149	203	27,580	191
65	0.145	24.1	32,500	252	31,578	241	29,879	224
70	0.156	26.0	35,000	279	34,007	276	32,177	260
75	0.167	27.8	37,500	332	36,437	316	34,475	297
80	0.178	29.7	40,000	379	38,866	360	36,774	339
85	0.189	31.6	42,500	428	41,295	407	39,072	384
90	0.201	33.4	45,000	477	43,724	454	41,370	428
95	0.212	35.3	47,500	531	46,153	506	43,669	477
100	0.223	37.1	50,000	588	48,582	561	45,967	529

per lb of water per deg temperature rise at 300 deg. *Example*—If 10 gpm of 300-deg water is flowing through 200 ft of new, clean, ¾-inch Schedule 40 pipe, the friction loss, from the tables, is 19.3 feet per 100 ft, or 38.6 ft of 60-deg water for the 200-ft length. Friction loss, in pounds per square inch, is 38.6 times the constant 0.433 psi per ft of 60-deg water, or 16.7 psi.

If this pipe serves a heat exchanger, sized for a 100-deg drop, then the heat transfer is the weight flow rate, 4,597 lb per hr (from the table), times 1.03 Btu per lb-deg, times 100 deg, or 473,000 Btuh.

FRICTION LOSS IN 1¼-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, Lb per Hr	Pressure Loss, Ft per 100 Ft
2	0.00446	0.429	1,000	0.102	972	0.0758	919	0.0644
3	0.00668	0.644	1,500	0.208	1,457	0.158	1,379	0.137
4	0.00891	0.858	2,000	0.345	1,943	0.266	1,839	0.233
5	0.0111	1.073	2,500	0.514	2,429	0.404	2,298	0.356
6	0.0134	1.29	3,000	0.708	2,915	0.565	2,758	0.501
7	0.0156	1.50	3,500	0.935	3,401	0.755	3,218	0.676
8	0.0178	1.72	4,000	1.19	3,887	0.972	3,677	0.870
9	0.0201	1.93	4,500	1.47	4,372	1.21	3,137	1.09
10	0.0223	2.15	5,000	1.79	4,858	1.48	4,597	1.34
12	0.0267	2.57	6,000	2.49	5,830	2.10	5,516	1.92
14	0.0312	3.00	7,000	3.31	6,801	2.82	6,435	2.58
16	0.0356	3.43	8,000	4.24	7,773	3.65	7,355	3.35
18	0.0401	3.86	9,000	5.29	8,745	4.59	8,274	4.22
20	0.0446	4.29	10,000	6.43	9,716	5.63	9,193	5.18
22	0.0490	4.72	11,000	7.68	10,688	6.77	10,113	6.26
24	0.0535	5.15	12,000	9.06	11,660	8.02	11,032	7.42
26	0.0579	5.58	13,000	10.5	12,631	9.37	11,951	8.69
28	0.0624	6.01	14,000	12.1	13,603	10.8	12,871	10.0
30	0.0668	6.44	15,000	13.8	14,575	12.4	13,790	11.5
32	0.0713	6.86	16,000	15.6	15,546	14.1	14,709	13.1
34	0.0758	7.29	17,000	17.5	16,518	15.9	15,629	14.7
36	0.0802	7.72	18,000	19.6	17,490	17.7	16,548	16.5
38	0.0847	8.15	19,000	21.7	18,461	19.7	11,467	18.3
40	0.0891	8.58	20,000	23.8	19,433	21.7	18,387	20.3
42	0.0936	9.01	21,000	26.2	20,404	24.0	19,306	22.4
44	0.0980	9.44	22,000	28.6	21,376	26.2	20,225	24.4
46	0.102	9.87	23,000	31.2	22,348	28.7	21,145	26.7
48	0.107	10.3	24,000	34.0	23,319	31.3	22,064	29.2
50	0.111	10.7	25,000	36.8	24,291	33.9	22,984	31.7
55	0.123	11.8	27,500	44.1	26,720	40.8	25,282	38.2
60	0.134	12.9	30,000	52.2	29,149	48.5	27,580	45.5
65	0.145	13.9	32,500	61.1	31,578	56.8	29,879	53.5
70	0.156	15.0	35,000	70.5	34,007	65.8	32,177	61.6
75	0.167	16.1	37,500	80.7	36,437	75.5	34,475	70.8
80	0.178	17.2	40,000	91.5	38,866	85.8	36,774	80.6
85	0.189	18.2	42,500	103	41,295	96.8	39,072	91.0
90	0.201	19.3	45,000	115	43,724	108	41,370	102
95	0.212	20.4	47,500	128	46,153	121	43,669	114
100	0.223	21.5	50,000	142	48,582	134	45,967	126
110	0.245	23.6	55,000	171	53,440	161	50,564	152
120	0.267	25.7	60,000	203	58,298	192	55,160	135
130	0.290	27.9	65,000	237	63,157	225	59,757	159
140	0.312	30.0	70,000	274	68,015	260	64,354	183
150	0.334	32.2	75,000	314	72,873	299	68,951	211

FRICTION LOSS IN 1½-INCH SCHEDULE 40 STEEL PIPE

Weight flow rate is given in thousands of pounds per hour.

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
2	0.00446	0.315	1	.0490	0.972	0.0358	0.919	0.0302
3	0.00668	0.473	1.5	.0993	1.457	0.0741	1.379	0.0632
4	0.00891	0.630	2	.165	1.943	0.125	1.838	0.108
5	0.0111	0.788	2.5	.243	2.429	0.188	2.298	0.164
6	0.0134	0.946	3	.336	2.915	0.263	2.758	0.231
7	0.0156	1.10	3.5	.443	3.401	0.350	3.218	0.308
8	0.0178	1.26	4	.562	3.887	0.449	3.677	0.398
9	0.0201	1.42	4.5	.695	4.372	0.560	4.137	0.498
10	0.0223	1.58	5	.839	4.858	0.682	4.597	0.610
12	0.0267	1.89	6	1.17	5.830	0.962	5.516	0.867
14	0.0312	2.21	7	1.54	6.801	1.29	6.435	1.16
16	0.0356	2.52	8	1.98	7.773	1.66	7.355	1.51
18	0.0401	2.84	9	2.45	8.745	2.09	8.274	1.90
20	0.0446	3.15	10	2.98	9.716	2.55	9.193	2.34
22	0.0490	3.47	11	3.56	10.69	3.08	10.11	2.82
24	0.0535	3.78	12	4.18	11.66	3.63	11.03	3.33
26	0.0579	4.10	13	4.85	12.63	4.25	11.95	3.92
28	0.0624	4.41	14	5.59	13.60	4.91	12.87	4.51
30	0.0668	4.73	15	6.35	14.57	5.60	13.79	5.17
32	0.0713	5.04	16	7.17	15.55	6.35	14.71	5.89
34	0.0758	5.36	17	8.04	16.52	7.15	15.63	6.60
36	0.0802	5.67	18	8.97	17.49	8.00	16.55	7.40
38	0.0847	5.99	19	10.3	18.46	9.21	17.47	
40	0.0891	6,30	20	11.0	19.43	9.84	18.39	9.15
42	0.0936	6.62	21	12.0	20.40	10.8	19.31	10.1
44	0.0980	6.93	22	13.1	21.38	11.8	20.23	11.0
46	0.102	7.25	23	14.3	22.35	12.9	21.14	12.0
48	0.107	7.56	24	15.5	23.32	14.1	22.06	13.1
50	0.111	7.88	25	16.8	24.29	15.3	22.98	14.2
55	0.123	8.67	27.5	20.2	26.72	18.5	25.28	17.2
60	0.134	9.46	30	23.8	29.15	21.8	27.58	20.4
65	0.145	10.2	32.5	27.7	31.58	25.5	29.88	23.8
70	0.156	11.0	35	32.0	34.01	29.5	32.18	27.6
75	0.167	11.8	37.5	36.6	36.44	33.8	34.48	31.7
80	0.178	12.6	40	41.4	38.87	38.5	36.77	36.1
85	0.189	13.4	42.5	46.6	41.29	43.4	39.07	40.7
90	0.201	14.2	45	52.1	43.72	48.6	41.37	45.7
95	0.212	15.0	47.5	57.8	46.15	54.0	43.67	50.8
100	0.223	15.8	50	63.9	48.58	59.8	45.97	56.0
110	0.245	17.3	55	77.0	53.44	72.2	50.56	67.7
120	0.267	18.9	60	91.3	58.30	85.9	55.16	80.6
130	0.290	20.5	65	107	63.16	101	59.76	94.5
140	0.312	22.1	70	123	68.01	117	64.35	110
150	0.334	23.6	75	141	72.87	134	68.95	126
160	0.356	25.2	80	161	77.73	152	73.55	143
170	0.379	26.8	85	181	82.59	172	78.14	162
180	0.401	28.4	90	202	87.45	192	82.74	18.1
190	0.423	29.9	95	225	92.31	214	87.34	20.2
200	0.446	31.5	100	248	97.16	236	91.93	22.3

FRICTION LOSS IN 2-INCH SCHEDULE 40 STEEL PIPE

Weight flow rate is given in thousands of pounds per hour.

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
2	0.00446	0.191	1	0.0150	0.972	0.0108	0.919	0.00897
4	0.00891	0.382	2	0.0498	1.943	0.0368	1.838	0.0313
6	0.0134	0.574	3	0.101	2.915	0.0766	2.758	0.0659
8	0.0178	0.765	4	0.168	3.887	0.130	3.677	0.113
10	0.0223	0.956	5	0.249	4.858	0.196	4.597	0.172
12	0.0267	1.15	6	0.346	5.830	0.275	5.516	0.244
14	0.0312	1.34	7	0.455	6.801	0.366	6.435	0.325
16	0.0356	1.53	8	0.580	7.773	0.471	7.355	0.422
18	0.0401	1.72	9	0.717	8.745	0.588	8.274	0.529
20	0.0446	1.91	10	0.868	9.716	0.718	9.193	0.648
22	0.0490	2.10	11	1.03	10.69	0.861	10.11	0.777
24	0.0535	2.29	12	1.21	11.66	1.02	11.03	0.924
26	0.0579	2.49	13	1.40	12.63	1.18	11.95	1.08
28	0.0624	2.68	14	1.60	13.60	1.36	12.87	1.24
30	0.0668	2.87	15	1.83	14.57	1.56	13.79	1.42
35	0.0780	3.35	17.5	2.43	17.00	2.10	16.09	1.93
40	0.0891	3.82	20	3.11	19.43	2.71	18.39	2.50
45	0.100	4.30	22.5	3.89	21.86	3.42	20.69	3.14
50	0.111	4.78	25	4.74	24.29	4.19	22.98	3.87
55	0.123	5.26	27.5	5.67	26.72	5.05	25.28	4.69
60	0.134	5.74	30	6.68	29.15	5.98	27.58	5.52
65	0.145	6.21	32.5	7.79	31.58	7.00	29.88	6.48
70	0.156	6.69	35	8.96	34.01	8.09	32.18	7.52
75	0.167	7.17	37.5	10.2	36.44	9.26	34.48	8.63
80	0.178	7.65	40	11.6	38.87	10.5	36.77	9.82
85	0.189	8.13	42.5	13.0	41.29	11.9	39.07	11.1
90	0.201	8.60	45	14.5	43.72	13.2	41.37	12.4
95	0.212	9.08	47.5	16.1	46.15	14.7	43.67	13.7
100	0.223	9.56	50	17.8	48.58	16.3	45.97	15.2
110	0.245	10.5	55	21.3	53.44	19.7	50.56	18.4
120	0.267	11.5	60	25.3	58.30	23.4	55.16	21.9
130	0.290	12.4	65	29.5	63.16	27.4	59.76	25.7
140	0.312	13.4	70	34.0	68.01	31.7	64.35	29.7
150	0.334	14.3	75	39.0	72.87	36.4	68.95	34.2
160	0.356	15.3	80	44.2	77.73	41.4	73.55	38.9
170	0.379	16.3	85	49.7	82.59	46.6	78.14	44.0
180	0.401	17.2	90	55.5	87.45	52.1	82.74	48.8
190	0.423	18.2	95	61.7	92.31	58.1	87.34	54.4
200	0.446	19.1	100	68.2	97.16	64.2	91.93	60.2
220	0.490	21.0	110	82.4	106.9	77.7	101.1	72.9
240	0.535	22.9	120	97.6	116.6	92.4	110.3	86.7
260	0.579	24.9	130	114	126.3	108	119.5	102
280	0.624	26.8	140	132	136.0	125	128.7	118
300	0.668	28.7	150	152	145.7	144	137.9	136
320	0.713	30.6	160	171	155.5	163	147.1	154
340	0.758	32.5	170	194	165.2	184	156.3	174
360	0.802	34.4	180	217	174.9	207	165.5	195
380	0.847	36.3	190	242	184.6	230	174.7	217
400	0.891	38.2	200	267	194.3	255	183.9	241

FRICTION LOSS IN 2½-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
4	0.00891	0.268	2	0.0215	1.943	0.0157	1.838	0.0131
6	0.0134	0.402	3	0.0432	2.915	0.0322	2.758	0.0274
8	0.0178	0.536	4	0.0715	3.887	0.0542	3.677	0.0465
10	0.0223	0.670	5	0.106	4.858	0.0814	4.597	0.0705
12	0.0267	0.804	6	0.146	5.830	0.113	5.516	0.0990
14	0.0312	0.938	7	0.193	6.801	0.151	6.435	0.133
16	0.0356	1.07	8	0.245	7.773	0.194	7.355	0.172
18	0.0401	1.21	9	0.301	8.745	0.241	8.274	0.214
20	0.0446	1.34	10	0.365	9.716	0.294	9.193	0.262
22	0.0490	1.47	11	0.433	10.69	0.352	10.11	0.315
24	0.0535	1.61	12	0.507	11.66	0.414	11.03	0.372
26	0.0579	1.74	13	0.585	12.63	0.482	11.95	0.434
28	0.0624	1.88	14	0.667	13.60	0.555	12.87	0.501
30	0.0668	2.01	15	0.760	14.57	0.632	13.79	0.572
35	0.0780	2.35	17.5	1.01	17.00	0.849	16.09	0.771
40	0.0891	2.68	20	1.29	19.43	1.10	18.39	1.02
45	0.100	3.02	22.5	1.60	21.86	1.37	20.69	1.26
50	0.111	3.35	25	1.94	24.29	1.68	22.98	1.54
55	0.123	3.69	27.5	2.33	26.72	2.03	25.28	1.86
60	0.134	4.02	30	2.74	29.15	2.40	27.58	2.21
65	0.145	4.36	32.5	3.19	31.58	2.81	29.88	2.59
70	0.156	4.69	35	3.66	34.01	3.24	32.18	3.00
75	0.167	5.03	37.5	4.17	36.44	3.71	34.48	3.43
80	0.178	5.36	40	4.72	38.87	4.21	36.72	3.90
85	0.189	5.70	42.5	5.28	41.29	4.73	39.07	4.38
90	0.201	6.03	45	5.89	43.72	5.29	41.37	4.90
95	0.212	6.37	47.5	6.53	46.15	5.88	43.67	5.46
100	0.223	6.70	50	7.09	48.58	6.51	45.97	6.04
110	0.245	7.37	55	8.63	53.44	7.83	50.56	7.30
120	0.267	8.04	60	10.2	58.30	9.26	55.16	8.63
130	0.290	8.71	65	11.9	63.16	10.9	59.76	10.2
140	0.312	9.38	70	14.3	68.01	12.6	64.36	11.8
150	0.334	10.1	75	15.7	72.87	14.4	68.96	13.5
160	0.356	10.7	80	17.8	77.73	16.4	73.55	15.4
170	0.379	11.4	85	20.1	82.59	18.5	78.14	17.3
180	0.401	12.1	90	22.3	87.45	20.7	82.74	19.4
190	0.423	12.7	95	24.8	92.31	23.1	87.34	21.6
200	0.446	13.4	100	27.3	97.16	25.5	91.93	23.9
220	0.490	14.7	110	33.0	106.9	30.8	101.1	28.9
240	0.535	16.1	120	39.0	116.6	36.6	110.3	34.3
260	0.579	17.4	130	45.7	126.3	43.0	119.5	40.3
280	0.624	18.8	140	52.7	136.0	49.7	128.7	46.7
300	0.668	20.1	150	60.4	145.7	57.0	137.9	53.6
350	0.780	23.5	175	81.7	170.0	77.5	160.9	72.8
400	0.891	26.8	200	107	194.3	101	183.9	95.3
450	1.003	30.2	225	134	218.6	127	206.9	120
500	1.114	33.5	250	164	242.9	157	229.8	148
550	1.225	36.9	275	199	267.2	190	252.8	179
600	1.337	40.2	300	226	291.5	226	275.8	213

FRICTION LOSS IN 3-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
5	0.0111	0.217	2.5	0.0113	2.429	0.00732	2.298	0.00681
10	0.0223	0.434	5	0.0375	4.858	0.0281	4.596	0.0241
15	0.0334	0.651	7.5	0.0764	7.287	0.0587	6.895	0.0510
20	0.0446	0.868	10	0.128	9.716	0.0997	9.193	0.0876
25	0.0557	1.09	12.5	0.190	12.15	0.151	11.49	0.134
30	0.0668	1.30	15	0.262	14.57	0.212	13.79	0.189
35	0.0780	1.52	17.5	0.348	17.00	0.284	16.09	0.255
40	0.0891	1.74	20	0.442	19.43	0.365	18.39	0.329
45	0.100	1.95	22.5	0.549	21.86	0.458	20.69	0.413
50	0.111	2.17	25	0.666	24.29	0.559	22.98	0.507
55	0.123	2.39	27.5	0.792	26.72	0.670	25.28	0.609
60	0.134	2.60	30	0.927	29.15	0.789	27.58	0.720
65	0.145	2.82	32.5	1.08	31.58	0.926	29.88	0.847
70	0.156	3.04	35	1.24	34.01	1.06	32.18	0.974
75	0.167	3.25	37.5	1.41	36.44	1.22	34.48	1.12
80	0.178	3.47	40	1.59	38.87	1.38	36.77	1.27
85	0.189	3.69	42.5	1.77	41.29	1.55	39.07	1.42
90	0.201	3.91	45	1.97	43.72	1.73	41.37	1.60
95	0.212	4.12	47.5	2.19	46.15	1.92	43.67	1.77
100	0.223	4.34	50	2.46	48.58	2.16	45.97	1.97
110	0.245	4.77	55	2.89	53.44	2.56	50.56	2.37
120	0.267	5.21	60	3.40	58.30	3.03	55.16	2.81
130	0.290	5.64	65	3.99	63.16	3.55	59.76	3.30
140	0.312	6.08	70	4.56	68.01	4.10	64.35	3.82
150	0.334	6.51	75	5.21	72.87	4.71	68.95	4.38
160	0.356	6.94	80	5.88	77.73	5.33	73.55	4.97
170	0.379	7.38	85	6.61	82.59	6.01	78.14	5.59
180	0.401	7.81	90	7.37	87.45	6.72	82.74	6.27
190	0.423	8.25	95	8.20	92.31	7.50	87.34	7.00
200	0.446	8.68	100	9.01	97.16	8.27	91.93	7.71
220	0.490	9.55	110	10.9	106.9	10.0	101.1	9.34
240	0.535	10.4	120	12.8	116.6	11.9	110.3	11.1
260	0.579	11.3	130	15.0	126.3	13.9	119.5	13.0
280	0.624	12.2	140	17.2	136.0	16.0	128.7	15.0
300	0.668	13.0	150	19.7	145.7	18.4	137.9	17.2
320	0.713	13.9	160	22.4	155.5	20.9	147.1	19.7
340	0.758	14.8	170	25.2	165.2	23.6	156.3	22.1
360	0.802	15.6	180	28.2	174.9	26.4	165.5	24.8
380	0.847	16.5	190	31.3	184.6	29.4	174.7	27.7
400	0.891	17.4	200	34.6	194.3	32.5	183.9	30.6
420	0.936	18.2	210	38.1	204.0	35.9	193.1	33.7
440	0.980	19.1	220	41.7	213.8	39.3	202.2	37.0
460	1.025	20.0	230	45.5	223.5	43.0	211.4	40.4
480	1.069	20.8	240	49.5	233.2	46.8	220.6	43.9
500	1.114	21.7	250	53.6	242.9	50.7	229.8	47.7
600	1.337	26.0	300	76.5	291.5	72.7	275.8	68.4
700	1.560	30.4	350	104	340.1	98.8	321.8	93.1
800	1.782	34.7	400	135	388.7	129	367.7	122
1,000	2.228	43.4	500	210	485.8	202	459.7	190

FRICTION LOSS IN 3½-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
5	0.0111	0.162	2.5	0.00564	2.429	0.00406	2.298	0.00337
10	0.0223	0.323	5	0.0188	4.858	0.0139	4.597	0.0118
15	0.0334	0.487	7.5	0.0380	7.287	0.0288	6.895	0.0248
20	0.0446	0.649	10	0.0632	9.716	0.0487	9.193	0.0423
25	0.0557	0.811	12.5	0.0936	12.15	0.117	11.49	0.0642
30	0.0668	0.974	15	0.130	14.57	0.103	13.79	0.0907
35	0.0780	1.14	17.5	0.171	17.00	0.137	16.09	0.121
40	0.0891	1.30	20	0.218	19.43	0.176	18.39	0.157
45	0.100	1.46	22.5	0.269	21.86	0.219	20.69	0.197
50	0.111	1.62	25	0.326	24.29	0.268	22.98	0.241
60	0.134	1.95	30	0.455	29.15	0.379	27.58	0.343
70	0.156	2.27	35	0.604	34.01	0.509	32.18	0.463
80	0.178	2.60	40	0.774	38.87	0.658	36.77	0.602
90	0.201	2.92	45	0.963	43.72	0.827	41.37	0.758
100	0.223	3.25	50	1.17	48.58	1.01	45.97	0.930
110	0.245	3.57	55	1.40	53.44	1.22	50.56	1.12
120	0.267	3.89	60	1.64	58.30	1.44	55.16	1.33
130	0.290	4.22	65	1.91	63.16	1.68	59.76	1.55
140	0.312	4.54	70	2.20	68.01	1.95	64.35	1.80
150	0.334	4.87	75	2.50	72.87	2.22	68.95	2.06
160	0.356	5.19	80	2.82	77.73	2.52	73.55	2.34
170	0.379	5.52	85	3.17	82.59	2.96	78.14	2.63
180	0.401	5.84	90	3.53	87.45	3.17	82.74	2.95
190	0.423	6.17	95	3.91	92.31	3.53	87.34	3.28
200	0.446	6.49	100	4.32	97.16	3.90	91.93	3.63
220	0.490	7.14	110	5.18	106.9	4.70	101.3	4.38
240	0.535	7.79	120	6.12	116.6	5.58	110.3	5.21
260	0.579	8.44	130	7.16	126.3	6.56	119.5	6.13
280	0.624	9.09	140	8.22	136.0	7.55	128.7	7.05
300	0.668	9.74	150	9.39	145.7	8.66	137.9	8.09
320	0.713	10.4	160	10.6	155.5	9.86	147.1	9.22
340	0.758	11.0	170	12.0	165.2	11.1	156.3	10.4
360	0.802	11.7	180	13.4	174.9	12.4	165.5	11.6
380	0.847	12.3	190	14.8	184.6	13.8	174.7	12.9
400	0.891	13.0	200	16.4	194.3	15.3	183.9	14.4
420	0.936	13.6	210	18.1	204.0	16.9	193.1	15.8
440	0.980	14.3	220	21.6	213.8	18.5	202.2	17.3
460	1.025	14.9	230	21.5	223.5	20.2	211.4	18.9
480	1.069	15.6	240	23.4	233.2	21.9	220.6	20.6
500	1.114	16.2	250	30.7	242.9	23.8	229.8	22.4
600	1.337	19.5	300	36.2	291.5	34.2	275.8	32.2
700	1.560	22.7	350	49.1	340.0	46.4	321.8	43.7
800	1.782	26.0	400	63.8	388.7	60.7	367.7	57.1
1,000	2.228	32.5	500	99.2	485.8	94.6	459.7	89.1
1,100	2.451	35.7	550	119	534.4	114	505.6	108
1,200	2.674	38.9	600	142	583.0	136	551.6	128
1,300	2.896	42.2	650	166	631.6	160	597.6	150
1,400	3.119	45.4	700	193	680.1	185	643.5	174
1,500	3.342	48.7	750	221	728.7	212	689.5	200

FRICTION LOSS IN 4-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
20	0.0446	0.504	10	0.0345	9.716	0.0262	9.193	0.0226
30	0.0668	0.756	15	0.0706	14.57	0.0550	13.79	0.0481
40	0.0981	1.01	20	0.118	19.43	0.0939	18.39	0.0831
50	0.111	1.26	25	0.176	24.29	0.143	22.98	0.127
60	0.134	1.51	30	0.245	29.15	0.201	27.58	0.180
70	0.156	1.76	35	0.325	34.01	0.269	32.18	0.242
80	0.178	2.02	40	0.414	38.87	0.347	36.77	0.315
90	0.201	2.27	45	0.514	43.72	0.434	41.37	0.395
100	0.223	2.52	50	0.624	48.58	0.532	45.97	0.485
110	0.245	2.77	55	0.741	53.44	0.637	50.56	0.582
120	0.267	3.02	60	0.875	58.30	0.754	55.16	0.692
130	0.290	3.28	65	1.02	63.16	0.882	59.76	0.810
140	0.312	3.53	70	1.16	68.01	1.02	64.35	0.934
150	0.334	3.78	75	1.33	72.87	1.16	68.95	1.07
160	0.356	4.03	80	1.50	77.73	1.32	73.55	1.22
170	0.379	4.28	85	1.68	82.59	1.48	78.14	1.37
180	0.401	4.54	90	1.87	87.45	1.66	82.74	1.54
190	0.423	4.78	95	2.07	92.31	1.84	87.34	1.71
200	0.446	5.04	100	2.28	97.16	2.04	91.93	1.89
220	0.490	5.54	110	2.74	106.9	2.46	101.1	2.28
240	0.535	6.05	120	3.23	116.6	2.91	110.3	2.70
260	0.579	6.55	130	3.76	126.3	3.40	119.5	3.17
280	0.624	7.06	140	4.33	136.0	3.94	128.7	3.67
300	0.668	7.56	150	4.94	145.7	4.51	137.9	4.20
320	0.713	8.06	160	5.59	155.5	5.12	147.1	4.78
340	0.758	8.57	170	6.28	165.2	5.77	156.3	5.38
360	0.802	9.07	180	7.01	174.9	6.46	165.5	6.04
380	0.847	9.58	190	7.81	184.6	7.21	174.7	6.74
400	0.891	10.1	200	8.59	194.3	7.95	183.9	7.44
420	0.936	10.6	210	9.47	204.0	8.75	193.1	8.20
440	0.980	11.1	220	10.3	213.8	9.59	202.2	8.98
460	1.025	11.6	230	11.3	223.5	10.5	211.4	9.82
480	1.069	12.1	240	12.2	233.2	11.4	220.6	10.7
500	1.114	12.6	250	13.3	242.9	12.4	229.8	11.6
600	1.337	15.1	300	18.9	291.5	17.7	275.8	16.6
700	1.560	17.6	350	25.6	340.1	24.1	321.8	22.7
800	1.782	20.2	400	33.2	388.7	31.4	367.7	29.5
900	2.005	22.7	450	41.8	437.2	39.7	413.7	37.4
1,000	2.228	25.2	500	51.5	485.8	48.9	459.7	46.0
1,100	2.451	27.7	550	62.0	534.4	58.9	505.6	55.5
1,200	2.674	30.2	600	73.6	583.0	70.1	551.6	66.2
1,300	2.896	32.8	650	86.5	631.6	82.5	597.6	77.8
1,400	3.119	35.3	700	99.8	680.1	95.3	643.5	89.9
1,500	3.342	37.8	750	115	728.7	109	689.5	103
1,600	3.565	40.3	800	130	777.3	125	735.5	118
1,700	3.788	42.8	850	147	825.9	141	781.4	133
1,800	4.010	45.0	900	165	874.5	158	827.4	149
1,900	4.233	47.9	950	183	923.1	176	873.4	166
2,000	4.456	50.4	1,000	203	971.6	195	919.3	184

FRICTION LOSS IN 5-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
20	0.0446	0.321	10	0.0117	9.716	0.00872	9.193	0.00742
40	0.0891	0.641	20	0.0396	19.43	0.0307	18.39	0.0267
60	0.134	0.962	30	0.0816	29.15	0.0649	27.58	0.0575
80	0.178	1.28	40	0.137	38.87	0.111	36.77	0.0996
100	0.223	1.60	50	0.206	48.58	0.170	45.97	0.153
120	0.267	1.92	60	0.286	58.30	0.240	55.16	0.218
140	0.312	2.25	70	0.381	68.01	0.322	64.35	0.293
160	0.356	2.57	80	0.486	77.73	0.415	73.55	0.379
180	0.401	2.89	90	0.604	87.45	0.521	82.74	0.477
200	0.446	3.21	100	0.739	97.16	0.642	91.93	0.589
220	0.490	3.53	110	0.880	106.9	0.768	101.1	0.708
240	0.535	3.85	120	1.04	116.6	0.911	110.3	0.840
260	0.579	4.17	130	1.21	126.3	1.07	119.5	0.983
280	0.624	4.49	140	1.39	136.0	1.23	128.7	1.14
300	0.668	4.81	150	1.58	145.7	1.41	137.9	1.31
320	0.713	5.13	160	1.80	155.5	1.60	147.1	1.48
340	0.758	5.45	170	2.01	165.2	1.80	156.3	1.67
360	0.802	5.77	180	2.24	174.9	2.02	165.5	1.87
380	0.847	6.09	190	2.48	184.6	2.24	174.7	2.08
400	0.891	6.41	200	2.73	194.3	2.47	183.9	2.30
420	0.936	6.74	210	3.00	204.0	2.72	193.1	2.54
440	0.980	7.06	220	3.27	213.8	2.99	202.3	2.78
460	1.02	7.38	230	3.58	223.5	3.26	211.4	3.04
480	1.07	7.70	240	3.88	233.2	3.55	220.6	3.31
500	1.11	8.02	250	4.19	242.9	3.84	229.8	3.58
550	1.23	8.82	275	5.03	267.2	4.63	252.8	4.33
600	1.34	9.62	300	5.96	291.5	5.50	275.8	5.14
650	1.45	10.4	325	6.96	315.8	6.44	298.8	6.03
700	1.56	11.2	350	8.04	340.1	7.47	321.8	7.00
750	1.67	12.0	375	9.18	364.4	8.55	344.8	8.01
800	1.78	12.8	400	10.4	388.7	9.73	367.7	9.11
850	1.89	13.6	425	11.7	412.9	11.0	390.7	10.3
900	2.01	14.4	450	13.1	437.2	12.3	413.7	11.5
950	2.12	15.2	475	14.5	461.5	13.6	436.7	12.8
1,000	2.23	16.0	500	16.1	485.8	15.1	459.7	14.2
1,100	2.45	17.6	550	19.4	534.4	18.2	505.6	17.2
1,200	2.67	19.2	600	23.0	583.0	21.7	551.6	20.4
1,300	2.90	20.8	650	26.9	631.6	25.4	597.6	23.9
1,400	3.12	22.5	700	31.1	680.1	29.4	643.5	27.7
1,500	3.34	24.1	750	35.6	728.7	33.8	689.5	31.8
1,600	3.56	25.7	800	40.3	777.3	38.4	735.5	36.1
1,700	3.79	27.3	850	45.8	825.9	43.6	781.4	41.1
1,800	4.01	28.8	900	50.8	874.5	48.4	827.4	45.7
1,900	4.23	30.5	950	56.6	923.1	54.0	873.4	51.0
2,000	4.46	32.1	1,000	62.9	971.6	60.0	919.3	56.5
2,100	4.68	33.7	1,050	69.0	102.0	66.0	965.3	62.1
2,200	4.90	35.3	1,100	75.7	106.9	72.4	1,011	68.1
2,300	5.12	36.9	1,150	82.7	111.7	79.1	1,057	74.5
2,500	5.57	40.1	1,250	97.8	121.5	93.5	1,149	88.3

FRICTION LOSS IN 6-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
20	0.0446	0.222	10	0.00489	9.716	0.00359	9.193	0.00302
40	0.0891	0.444	20	0.0164	19.43	0.0125	18.39	0.0107
60	0.134	0.666	30	0.0336	29.15	0.0262	27.58	0.0228
80	0.178	0.888	40	0.0562	38.87	0.0446	36.77	0.0394
100	0.223	1.11	50	0.0841	48.58	0.0676	45.97	0.0602
120	0.267	1.33	60	0.117	58.30	0.0952	55.16	0.0852
140	0.312	1.55	70	0.155	68.01	0.127	64.35	0.115
160	0.356	1.78	80	0.197	77.73	0.164	73.55	0.148
180	0.401	2.00	90	0.245	87.45	0.206	82.74	0.186
200	0.446	2.22	100	0.297	97.16	0.252	91.93	0.229
220	0.490	2.44	110	0.353	106.9	0.302	101.2	0.275
240	0.535	2.66	120	0.415	116.6	0.355	110.3	0.325
260	0.579	2.89	130	0.484	126.3	0.417	119.5	0.383
280	0.624	3.11	140	0.554	136.0	0.480	128.7	0.440
300	0.668	3.33	150	0.628	145.7	0.547	137.9	0.503
320	0.713	3.55	160	0.710	155.4	0.621	147.1	0.572
340	0.758	3.78	170	0.797	165.2	0.702	156.3	0.647
360	0.802	4.00	180	0.857	174.9	0.756	165.5	0.698
380	0.847	4.22	190	0.983	184.6	0.870	174.7	0.804
400	0.891	4.44	200	1.08	194.3	0.961	183.9	0.889
420	0.936	4.66	210	1.19	204.0	1.06	193.1	0.978
440	0.980	4.89	220	1.29	213.8	1.16	202.2	1.07
460	1.025	5.11	230	1.40	223.5	1.26	211.4	1.17
480	1.07	5.33	240	1.53	233.2	1.37	220.6	1.27
500	1.11	5.55	250	1.64	242.9	1.48	229.8	1.38
600	1.34	6.66	300	2.33	291.5	2.13	275.8	1.98
700	1.56	7.77	350	3.13	340.1	2.87	321.8	2.68
800	1.78	8.88	400	4.06	388.7	3.75	367.7	3.51
900	2.01	9.99	450	5.08	437.2	4.71	413.7	4.41
1,000	2.23	11.1	500	6.24	485.8	5.84	459.7	5.46
1,100	2.45	12.2	550	7.49	534.4	7.03	505.6	6.58
1,200	2.67	13.3	600	8.89	583.0	8.34	551.6	7.82
1,300	2.90	14.4	650	10.4	631.6	9.78	597.6	9.18
1,400	3.12	15.5	700	12.0	680.1	11.4	643.5	10.6
1,500	3.34	16.7	750	13.7	728.7	13.0	689.5	12.2
1,600	3.56	17.8	800	15.6	777.3	14.8	735.5	13.9
1,700	3.79	18.9	850	17.6	825.9	16.7	781.4	15.7
1,800	4.01	20.0	900	19.7	874.5	18.6	827.4	17.5
1,900	4.23	21.1	950	21.9	923.1	20.8	873.4	19.5
2,000	4.46	22.2	1,000	24.2	971.6	23.0	919.3	21.6
2,100	4.68	23.3	1,050	26.7	1,020	25.4	965.3	23.8
2,200	4.90	24.4	1,100	29.3	1,069	27.8	1,011	26.2
2,300	5.12	25.5	1,150	31.8	1,117	30.3	1,057	28.5
2,400	5.35	26.6	1,200	34.7	1,166	33.0	1,103	31.0
2,500	5.57	27.8	1,250	37.8	1,215	35.9	1,149	33.8
2,600	5.79	28.9	1,300	40.8	1,263	38.9	1,195	36.6
2,700	6.02	30.0	1,350	44.0	1,312	41.9	1,241	39.4
2,800	6.24	31.1	1,400	47.0	1,360	44.9	1,287	42.3
3,000	6.68	33.3	1,500	53.7	1,457	51.4	1,379	48.4

FRICTION LOSS IN 8-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
20	0.0446	0.128	10	0.00130	9.716	0.000940	9.193	0.000783
40	0.0891	0.257	20	0.00431	19.43	0.00320	18.39	0.00272
60	0.134	0.385	30	0.00881	29.49	0.00667	27.58	0.00573
80	0.178	0.513	40	0.0146	38.87	0.0113	36.77	0.00978
100	0.223	0.641	50	0.0217	48.58	0.0170	45.97	0.0149
120	0.267	0.770	60	0.0301	58.30	0.0238	55.16	0.0210
140	0.312	0.898	70	0.0398	68.01	0.0316	64.35	0.0280
160	0.356	1.03	80	0.0507	77.73	0.0408	73.55	0.0362
180	0.401	1.15	90	0.0625	87.45	0.0507	82.74	0.0453
200	0.446	1.28	100	0.0758	97.16	0.0620	91.93	0.0556
220	0.490	1.41	110	0.0899	106.9	0.0742	101.1	0.0667
240	0.535	1.54	120	0.105	116.6	0.0876	110.3	0.0788
260	0.579	1.67	130	0.122	126.3	0.102	119.5	0.0920
280	0.624	1.80	140	0.140	136.0	0.117	128.7	0.106
300	0.668	1.92	150	0.159	145.7	0.134	137.9	0.121
320	0.713	2.05	160	0.179	155.5	0.151	147.1	0.138
340	0.758	2.18	170	0.200	165.2	0.170	156.2	0.155
360	0.802	2.31	180	0.222	174.9	0.190	165.5	0.173
380	0.847	2.44	190	0.246	184.6	0.210	174.7	0.193
400	0.891	2.57	200	0.269	194.3	0.232	183.9	0.212
450	1.003	2.89	225	0.335	218.6	0.290	206.9	0.267
500	1.11	3.21	250	0.410	242.9	0.358	229.8	0.330
550	1.23	3.53	275	0.488	267.2	0.430	252.8	0.396
600	1.34	3.85	300	0.577	291.5	0.511	275.8	0.472
650	1.45	4.17	325	0.675	315.8	0.599	298.8	0.553
700	1.56	4.49	350	0.773	340.1	0.689	321.8	0.639
750	1.67	4.81	375	0.882	364.4	0.788	344.8	0.731
800	1.78	5.13	400	0.994	388.7	0.896	367.7	0.830
850	1.89	5.45	425	1.12	412.9	1.01	390.7	0.938
900	2.01	5.77	450	1.25	437.2	1.13	413.7	1.05
950	2.12	6.09	475	1.38	461.5	1.25	436.7	1.17
1,000	2.23	6.41	500	1.52	485.8	1.39	459.7	1.29
1,200	2.67	7.70	600	2.16	583.0	1.98	551.6	1.85
1,400	3.12	8.98	700	2.90	680.1	2.69	643.5	2.51
1,600	3.56	10.3	800	3.77	777.3	3.51	735.5	3.28
1,800	4.01	11.5	900	4.64	874.5	4.41	827.4	4.14
2,000	4.46	12.8	1,000	5.84	971.6	5.45	919.3	5.12
2,200	4.90	14.1	1,100	6.98	1,069	6.55	1,011	6.18
2,400	5.35	15.4	1,200	8.32	1,166	7.80	1,103	7.36
2,600	5.79	16.7	1,300	9.72	1,263	9.16	1,195	8.60
2,800	6.24	18.0	1,400	11.2	1,360	10.6	1,287	9.97
3,000	6.68	19.2	1,500	12.9	1,457	12.2	1,379	11.4
3,200	7.13	20.5	1,600	14.6	1,555	13.8	1,471	13.0
3,400	7.58	21.8	1,700	17.4	1,652	15.6	1,563	14.7
3,600	8.02	23.1	1,800	18.4	1,749	17.5	1,655	16.5
3,800	8.47	24.4	1,900	20.5	1,846	19.5	1,747	18.4
4,000	8.91	25.7	2,000	22.6	1,943	21.5	1,839	20.2
4,500	10.03	28.9	2,250	28.5	2,186	27.2	2,069	25.5
5,000	11.1	32.1	2,500	35.2	2,429	33.6	2,298	31.7

FRICTION LOSS IN 10-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
100	0.223	0.407	50	0.00725	48.58	0.00555	45.96	0.00478
120	0.267	0.488	60	0.00999	58.30	0.00773	55.16	0.00670
140	0.312	0.570	70	0.0132	68.01	0.0103	64.35	0.00895
160	0.356	0.651	80	0.0167	77.73	0.0131	73.55	0.0115
180	0.401	0.732	90	0.0207	87.45	0.0163	82.74	0.0144
200	0.446	0.814	100	0.0249	97.16	0.0199	91.93	0.0176
220	0.490	0.895	110	0.0296	106.9	0.0239	101.1	0.0211
240	0.535	0.976	120	0.0346	116.6	0.0280	110.3	0.0249
260	0.579	1.06	130	0.0402	126.3	0.0325	119.5	0.0289
280	0.624	1.14	140	0.0459	136.0	0.0374	128.7	0.0333
300	0.668	1.22	150	0.0520	145.7	0.0427	137.9	0.0380
350	0.780	1.42	175	0.0687	170.0	0.0570	160.9	0.0513
400	0.891	1.63	200	0.0878	194.3	0.0733	183.9	0.0663
450	1.003	1.83	225	0.109	218.6	0.0917	206.9	0.0834
500	1.11	2.03	250	0.132	242.9	0.113	229.8	0.102
550	1.23	2.24	275	0.157	267.2	0.135	252.8	0.123
600	1.34	2.44	300	0.185	291.5	0.159	275.8	0.145
650	1.45	2.64	325	0.215	315.8	0.186	298.8	0.171
700	1.56	2.85	350	0.247	340.1	0.214	321.8	0.197
750	1.67	3.05	375	0.281	364.4	0.247	344.8	0.226
800	1.78	3.25	400	0.318	388.7	0.279	367.7	0.257
850	1.89	3.46	425	0.355	412.9	0.312	390.7	0.288
900	2.01	3.66	450	0.395	437.2	0.349	413.7	0.322
950	2.12	3.87	475	0.438	461.5	0.387	436.7	0.360
1,000	2.23	4.07	500	0.483	485.8	0.429	459.7	0.396
1,200	2.67	4.88	600	0.681	583.0	0.614	551.6	0.570
1,400	3.12	5.70	700	0.917	680.1	0.832	643.5	0.771
1,600	3.56	6.51	800	1.18	777.3	1.08	735.5	1.00
1,800	4.01	7.32	900	1.48	874.5	1.36	827.4	1.27
2,000	4.46	8.14	1,000	1.81	971.6	1.68	919.3	1.57
2,200	4.90	8.95	1,100	2.19	1,069	2.03	1,011	1.90
2,400	5.35	9.76	1,200	2.58	1,166	2.40	1,103	2.23
2,600	5.79	10.6	1,300	3.03	1,263	2.82	1,195	2.63
2,800	6.24	11.4	1,400	3.49	1,360	3.25	1,287	3.05
3,000	6.68	12.2	1,500	3.99	1,457	3.74	1,379	3.50
3,200	7.13	13.0	1,600	4.52	1,555	4.23	1,471	3.97
3,400	7.58	13.8	1,700	5.07	1,652	4.78	1,563	4.48
3,600	8.02	14.6	1,800	5.69	1,749	5.36	1,655	5.03
3,800	8.47	15.5	1,900	6.31	1,846	5.97	1,747	5.60
4,000	8.91	16.3	2,000	7.00	1,943	6.63	1,839	6.22
4,500	10.03	18.3	2,250	8.80	2,186	8.34	2,069	7.82
5,000	11.1	20.3	2,500	10.8	2,429	10.3	2,298	9.65
6,000	13.4	24.4	3,000	15.6	2,915	14.8	2,758	13.9
7,000	15.6	28.5	3,500	21.0	3,401	20.0	3,218	18.9
8,000	17.8	32.5	4,000	27.6	3,887	26.2	3,677	24.8
9,000	20.1	36.6	4,500	34.5	4,372	33.1	4,137	31.2
10,000	22.3	40.7	5,000	42.7	4,858	40.9	4,597	38.6

FRICTION LOSS IN 12-INCH SCHEDULE 40 STEEL PIPE

(Note: Weight flow rate is given in thousands of pounds per hour.)

Flow Rate		Velocity, Ft per Sec	60-Deg Water		180-Deg Water		300-Deg Water	
Gal per Min	Cu Ft per Sec		Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft	Flow Rate, 1000 Lb per Hr	Pressure Loss, Ft per 100 Ft
120	0.267	0.344	60	0.00445	58.30	0.00338	55.16	0.00291
140	0.312	0.401	70	0.00583	68.01	0.00448	64.35	0.00385
160	0.356	0.459	80	0.00739	77.73	0.00572	73.55	0.00497
180	0.401	0.516	90	0.00911	87.45	0.00708	82.74	0.00617
200	0.446	0.573	100	0.0110	97.16	0.00864	91.93	0.00751
220	0.490	0.631	110	0.0130	106.9	0.0103	101.1	0.00902
240	0.535	0.688	120	0.0152	116.6	0.0121	110.3	0.0106
260	0.579	0.745	130	0.0176	126.3	0.0140	119.5	0.0123
280	0.624	0.802	140	0.0201	136.0	0.0160	128.7	0.0142
300	0.668	0.860	150	0.0228	145.7	0.0183	137.9	0.0162
400	0.891	1.15	200	0.0384	194.3	0.0312	183.9	0.0279
500	1.11	1.43	250	0.0574	242.9	0.0479	229.8	0.0431
600	1.34	1.72	300	0.0805	291.5	0.0676	275.8	0.0612
700	1.56	2.01	350	0.107	340.1	0.0908	321.8	0.0826
800	1.78	2.29	400	0.136	388.7	0.118	367.7	0.107
900	2.01	2.58	450	0.170	437.2	0.146	413.7	0.135
1,000	2.23	2.87	500	0.207	485.8	0.180	459.7	0.166
1,200	2.67	3.44	600	0.293	583.0	0.258	551.6	0.237
1,400	3.12	4.01	700	0.312	680.1	0.348	643.5	0.320
1,600	3.56	4.59	800	0.504	777.3	0.451	735.5	0.419
1,800	4.01	5.16	900	0.629	874.5	0.567	827.4	0.530
2,000	4.46	5.73	1,000	0.772	971.6	0.700	919.3	0.649
2,200	4.90	6.31	1,100	0.927	1,069	0.840	1,011	0.785
2,400	5.35	6.88	1,200	1.10	1,166	1.00	1,103	0.933
2,600	5.79	7.45	1,300	1.28	1,263	1.17	1,195	1.10
2,800	6.24	8.03	1,400	1.47	1,361	1.35	1,287	1.26
3,000	6.68	8.60	1,500	1.68	1,457	1.55	1,379	1.45
3,200	7.13	9.17	1,600	1.90	1,555	1.77	1,471	1.65
3,400	7.58	9.75	1,700	2.15	1,652	2.00	1,563	1.86
3,600	8.02	10.3	1,800	2.39	1,749	2.21	1,655	2.08
3,800	8.47	10.9	1,900	2.65	1,846	2.47	1,747	2.32
4,000	8.91	11.5	2,000	3.04	1,943	2.73	1,839	2.57
4,500	10.03	12.9	2,250	3.70	2,186	3.47	2,069	3.26
5,000	11.1	14.3	2,500	4.53	2,429	4.27	2,298	3.99
5,500	12.3	15.8	2,750	5.44	2,672	5.13	2,528	4.83
6,000	13.4	17.2	3,000	6.49	2,915	6.12	2,758	5.75
6,500	14.5	18.6	3,250	7.60	3,158	7.17	2,988	6.74
7,000	15.6	20.1	3,500	8.76	3,401	8.33	3,218	7.83
7,500	16.7	21.5	3,750	10.1	3,644	9.55	3,448	8.98
8,000	17.8	22.9	4,000	11.4	3,887	10.9	3,677	10.2
8,500	18.9	24.4	4,250	12.8	4,129	12.3	3,907	11.5
9,000	20.1	25.8	4,500	14.3	4,372	13.7	4,137	12.9
9,500	21.2	27.2	4,750	16.0	4,615	15.2	4,367	14.4
10,000	22.3	28.7	5,000	17.7	4,858	16.9	4,597	16.0
12,000	26.7	34.4	6,000	25.3	5,830	24.2	5,516	22.9
14,000	31.2	40.1	7,000	34.5	6,801	33.0	6,435	31.3
16,000	35.6	45.9	8,000	44.8	7,773	43.2	7,355	40.9
18,000	40.1	51.6	9,000	56.7	8,745	54.6	8,274	51.8
20,000	44.6	57.3	10,000	70.0	9,716	67.5	9,193	63.9

THE DISCOMFORT INDEX

(Continued)

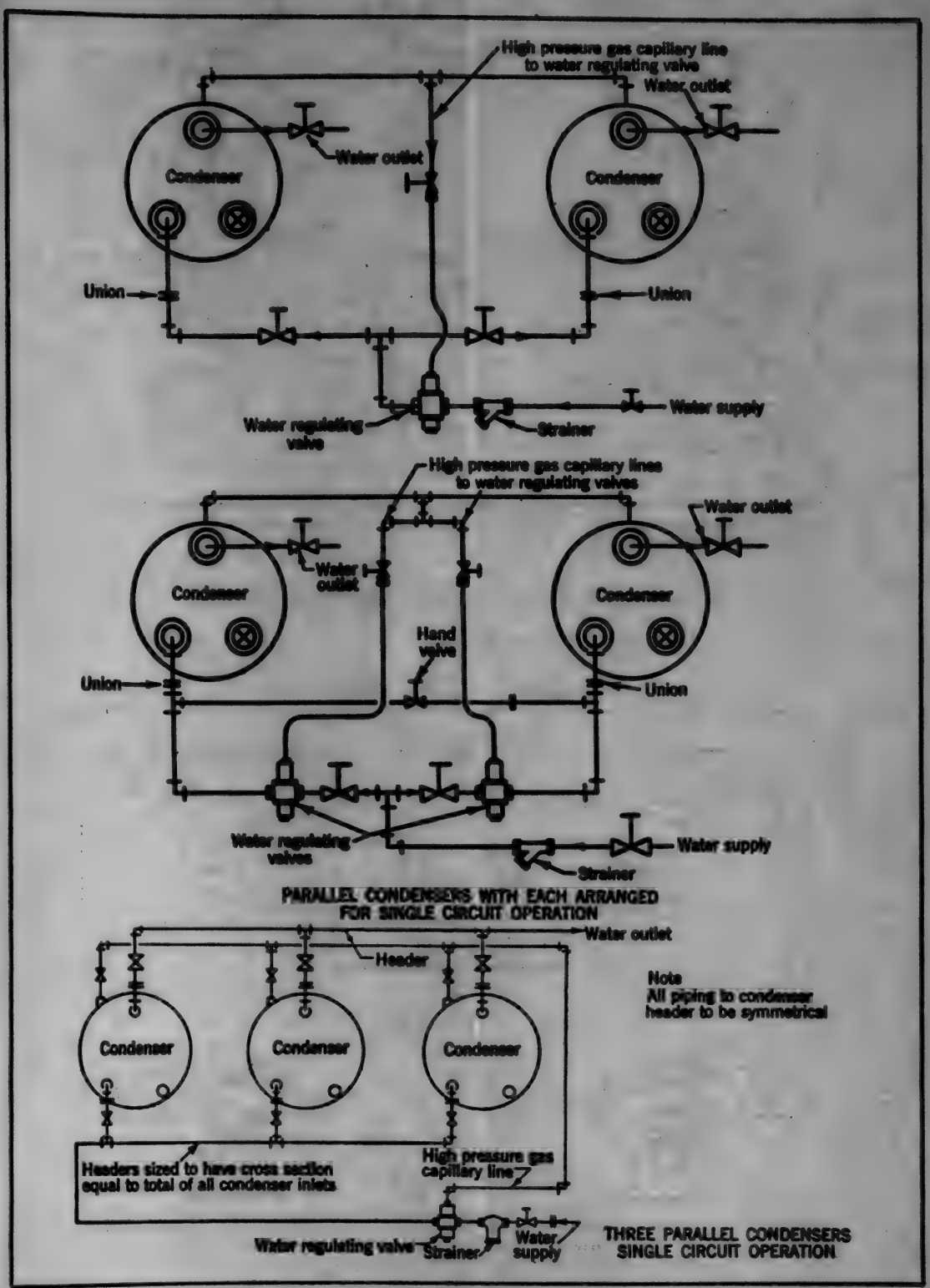
Dry Bulb Temperature, Deg F	Relative Humidity, Per Cent																
	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
	Discomfort Index																
70	67.2	67.3	67.4	67.4	67.5	67.6	67.6	67.7	67.8	67.8	67.9	68.0	68.0	68.1	68.2	68.2	68.3
71	68.0	68.1	68.1	68.2	68.3	68.4	68.4	68.5	68.6	68.6	68.7	68.8	68.9	68.9	69.0	69.1	69.1
72	68.8	68.8	68.9	69.0	69.1	69.2	69.2	69.3	69.4	69.5	69.5	69.6	69.7	69.8	69.8	69.9	70.0
73	69.5	69.6	69.7	69.8	69.9	69.9	70.0	70.1	70.2	70.3	70.4	70.4	70.5	70.6	70.7	70.8	70.9
74	70.3	70.4	70.5	70.6	70.7	70.7	70.8	70.9	71.0	71.1	71.2	71.3	71.4	71.4	71.5	71.6	71.7
75	71.1	71.2	71.3	71.4	71.4	71.5	71.6	71.7	71.8	71.9	72.0	72.1	72.2	72.3	72.4	72.5	72.6
76	71.8	71.9	72.0	72.1	72.2	72.3	72.4	72.5	72.6	72.7	72.8	72.9	73.0	73.1	73.2	73.3	73.4
77	72.6	72.7	72.8	72.9	73.0	73.1	73.2	73.3	73.4	73.6	73.7	73.8	73.9	74.0	74.1	74.2	74.3
78	73.4	73.5	73.6	73.7	73.8	73.9	74.0	74.2	74.3	74.4	74.5	74.6	74.7	74.8	74.9	75.0	75.1
79	74.1	74.3	74.4	74.5	74.6	74.7	74.8	75.0	75.1	75.2	75.3	75.4	75.5	75.7	75.8	75.9	76.0
80	74.9	75.0	75.2	75.3	75.4	75.5	75.6	75.8	75.9	76.0	76.1	76.2	76.4	76.5	76.6	76.7	76.9
81	75.7	75.8	75.9	76.1	76.2	76.3	76.4	76.6	76.7	76.8	77.0	77.1	77.2	77.3	77.5	77.6	77.7
82	76.5	76.6	76.7	76.9	77.0	77.1	77.2	77.4	77.5	77.6	77.8	77.9	78.0	78.2	78.3	78.4	78.5
83	77.2	77.4	77.5	77.6	77.8	77.9	78.1	78.2	78.3	78.5	78.6	78.7	78.9	79.0	79.2	79.3	79.4
84	78.0	78.1	78.3	78.4	78.6	78.7	78.9	79.0	79.1	79.3	79.4	79.6	79.7	79.9	80.0	80.1	80.3
85	78.8	78.9	79.1	79.2	79.4	79.5	79.7	79.8	80.0	80.1	80.2	80.4	80.5	80.7	80.8	81.0	81.1
86	79.5	79.7	79.8	80.0	80.1	80.3	80.5	80.6	80.8	80.9	81.1	81.2	81.4	81.5	81.7	81.8	82.0
87	80.3	80.5	80.6	80.8	80.9	81.1	81.3	81.4	81.6	81.7	81.9	82.1	82.2	82.4	82.5	82.7	82.9
88	81.1	81.2	81.4	81.5	81.7	81.9	82.1	82.2	82.4	82.6	82.7	82.9	83.1	83.2	83.4	83.5	83.7
89	81.8	82.0	82.2	82.4	82.5	82.7	82.9	83.0	83.2	83.4	83.5	83.7	83.9	84.1	84.2	84.4	84.6
90	82.6	82.8	83.0	83.1	83.3	83.5	83.7	83.8	84.0	84.2	84.4	84.5	84.7	84.9	85.1	85.2	85.4
91	83.4	83.5	83.7	83.9	84.1	84.3	84.5	84.6	84.8	85.0	85.2	85.4	85.6	85.7	85.9	86.1	86.3
92	84.1	84.3	84.5	84.7	84.9	85.1	85.3	85.5	85.6	85.8	86.0	86.2	86.4	86.6	86.8	87.0	87.1
93	84.9	85.1	85.3	85.5	85.7	85.9	86.1	86.3	86.5	86.6	86.8	87.0	87.2	87.4	87.5	87.8	88.0
94	85.7	85.9	86.1	86.3	86.5	86.7	86.9	87.1	87.3	87.5	87.7	87.9	88.1	88.3	88.5	88.7	88.9
95	86.4	86.7	86.9	87.1	87.3	87.5	87.7	87.9	88.1	88.3	88.5	88.7	88.9	89.1	89.3	89.5	89.7
96	87.2	87.4	87.6	87.8	88.1	88.3	88.5	88.7	88.9	89.1	89.3	89.5	89.7	89.9	90.1	90.4	90.6
97	88.0	88.2	88.4	88.6	88.8	89.1	89.3	89.5	89.7	89.9	90.1	90.4	90.6	90.8	91.0	91.2	91.4
98	88.8	89.0	89.2	89.4	89.6	89.9	90.1	90.3	90.5	90.7	91.0	91.2	91.4	91.6	91.8	92.1	92.3
99	89.5	89.8	90.0	90.2	90.4	90.7	90.9	91.1	91.3	91.6	91.8	92.0	92.2	92.5	92.7	92.9	93.1
100	90.3	90.5	90.8	91.0	91.2	91.5	91.7	91.9	92.1	92.4	92.6	92.8	93.1	93.3	93.6	93.8	94.0
102	91.8	92.1	92.3	92.6	92.8	93.0	93.3	93.5	93.8	94.0	94.3	94.5	94.7	95.0	95.2	95.5	95.7
104	93.4	93.6	93.9	94.1	94.4	94.6	94.9	95.1	95.4	95.7	95.9	96.2	96.4	96.7	96.9	97.2	97.4
106	94.9	95.2	95.4	95.7	96.0	96.2	96.5	96.8	97.0	97.3	97.6	97.8	98.1	98.3	98.6	98.9	99.1
108	96.5	96.7	97.0	97.3	97.6	97.8	98.1	98.4	98.7	98.9	99.2	99.5	99.8	100.0	—	—	—
110	98.0	98.3	98.6	98.8	99.1	99.4	99.7	100.1	—	—	—	—	—	—	—	—	—
112	99.5	99.8	100.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
114	101.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
116	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

THE DISCOMFORT INDEX

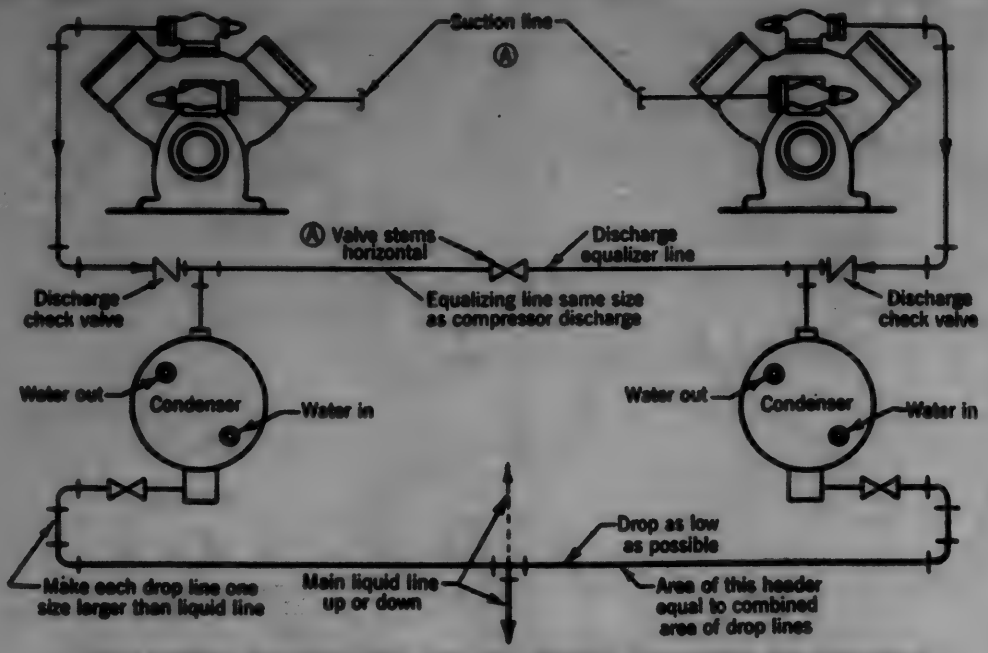
Dry Bulb Temperature, Deg F	Relative Humidity, Per Cent															
	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
	Discomfort Index															
70	68.4	68.4	68.5	68.5	68.6	68.7	68.7	68.8	68.9	68.9	69.0	69.1	69.1	69.2	69.3	69.3
71	69.2	69.3	69.4	69.4	69.5	69.6	69.6	69.7	69.8	69.9	69.9	70.0	70.1	70.1	70.2	70.3
72	70.1	70.2	70.2	70.3	70.4	70.5	70.5	70.6	70.7	70.8	70.8	70.9	71.0	71.1	71.2	71.2
73	70.9	71.0	71.1	71.2	71.3	71.4	71.4	71.5	71.6	71.7	71.8	71.8	71.9	72.0	72.1	72.2
74	71.8	71.9	72.0	72.1	72.1	72.2	72.3	72.4	72.5	72.6	72.7	72.8	72.9	72.9	73.0	73.1
75	72.7	72.8	72.8	72.9	73.0	73.1	73.2	73.3	73.4	73.5	73.6	73.7	73.8	73.9	74.0	74.1
76	73.5	73.6	73.7	73.8	73.9	74.0	74.1	74.2	74.3	74.4	74.5	74.6	74.7	74.8	74.9	75.0
77	74.4	74.5	74.6	74.7	74.8	74.9	75.0	75.1	75.2	75.3	75.4	75.5	75.6	75.7	75.9	76.0
78	75.3	75.4	75.5	75.6	75.7	75.8	75.9	76.0	76.1	76.2	76.4	76.5	76.6	76.7	76.8	76.9
79	76.1	76.2	76.3	76.5	76.6	76.7	76.8	76.9	77.0	77.1	77.3	77.4	77.5	77.6	77.7	77.8
80	77.0	77.1	77.2	77.3	77.5	77.6	77.7	77.8	77.9	78.1	78.2	78.3	78.4	78.5	78.7	78.8
81	77.8	78.0	78.1	78.2	78.3	78.5	78.6	78.7	78.8	79.0	79.1	79.2	79.4	79.5	79.6	79.7
82	78.7	78.8	79.0	79.1	79.2	79.4	79.5	79.6	79.8	79.9	80.0	80.2	80.3	80.4	80.5	80.7
83	79.6	79.7	79.8	80.0	80.1	80.3	80.4	80.5	80.7	80.8	80.9	81.1	81.2	81.4	81.5	81.6
84	80.4	80.6	80.7	80.9	81.0	81.1	81.3	81.4	81.5	81.7	81.9	82.0	82.1	82.3	82.4	82.6
85	81.3	81.4	81.5	81.7	81.9	82.0	82.2	82.3	82.5	82.6	82.8	82.9	83.1	83.2	83.4	83.5
86	82.2	82.3	82.5	82.6	82.8	82.9	83.1	83.2	83.4	83.5	83.7	83.8	84.0	84.2	84.3	84.5
87	83.0	83.2	83.3	83.5	83.7	83.8	84.0	84.1	84.3	84.4	84.6	84.8	84.9	85.1	85.2	85.4
88	83.9	84.0	84.2	84.4	84.5	84.7	84.9	85.0	85.2	85.4	85.5	85.7	85.9	86.0	86.2	86.4
89	84.7	84.9	85.1	85.2	85.4	85.6	85.8	85.9	86.1	86.3	86.4	86.6	86.8	87.0	87.1	87.3
90	85.6	85.8	86.0	86.1	86.3	86.5	86.7	86.8	87.0	87.2	87.4	87.5	87.7	87.9	88.1	88.3
91	86.5	86.6	86.8	87.0	87.2	87.4	87.6	87.7	87.9	88.1	88.3	88.5	88.6	88.8	89.0	89.2
92	87.3	87.5	87.7	87.9	88.1	88.3	88.4	88.6	88.8	89.0	89.2	89.4	89.6	89.8	89.9	90.1
93	88.2	88.4	88.6	88.8	89.0	89.2	89.3	89.5	89.7	89.9	90.1	90.3	90.5	90.7	90.9	91.1
94	89.1	89.2	89.4	89.6	89.8	90.0	90.2	90.4	90.6	90.8	91.0	91.2	91.4	91.6	91.8	92.0
95	89.9	90.1	90.3	90.5	90.7	90.9	91.1	91.3	91.5	91.7	91.9	92.2	92.4	92.6	92.8	93.0
96	90.8	91.0	91.2	91.4	91.6	91.8	92.0	92.2	92.4	92.7	92.9	93.1	93.3	93.5	93.7	93.9
97	91.6	91.8	92.1	92.3	92.5	92.7	92.9	93.1	93.4	93.6	93.8	94.0	94.2	94.4	94.6	94.9
98	92.5	92.7	92.9	93.2	93.4	93.6	93.8	94.0	94.3	94.5	94.7	94.9	95.1	95.4	95.6	95.8
99	93.4	93.6	93.8	94.0	94.3	94.5	94.7	94.9	95.2	95.4	95.6	95.8	96.1	96.3	96.5	96.7
100	94.2	94.5	94.7	94.9	95.1	95.4	95.6	95.8	96.1	96.3	96.5	96.8	97.0	97.2	97.5	97.7
102	96.0	96.2	96.4	96.7	96.9	97.2	97.4	97.6	97.9	98.1	98.4	98.6	98.9	99.1	99.3	99.6
104	97.7	97.9	98.2	98.4	98.7	98.9	99.2	99.4	99.7	100.0	—	—	—	—	—	—
106	99.4	99.7	99.9	100.2	—	—	—	—	—	—	—	—	—	—	—	—
108	101.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
110	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
112	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
114	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
116	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(Concluded next month)

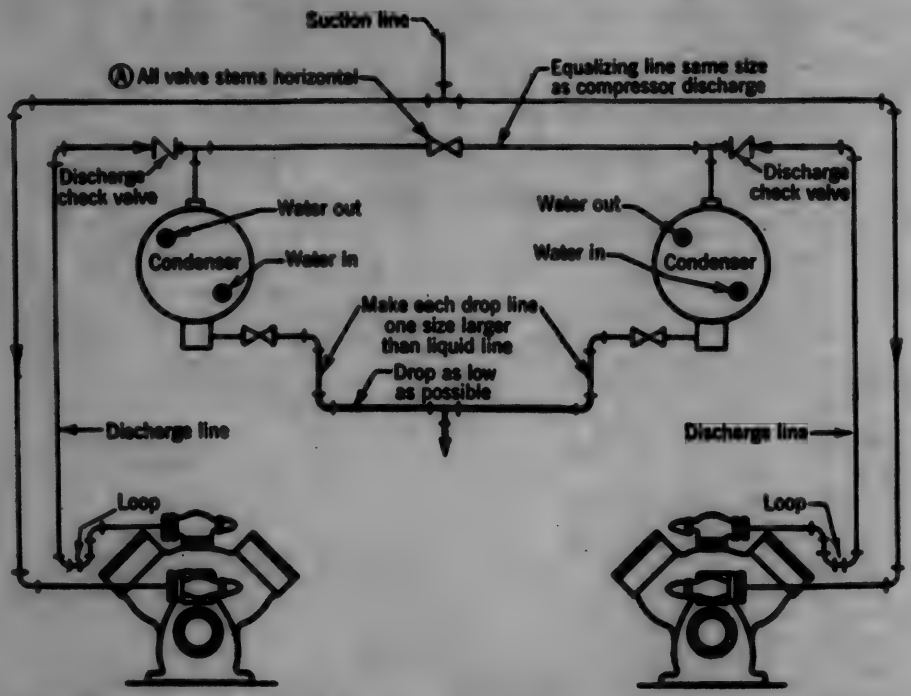
CONDENSER WATER PIPING



COMPRESSOR AND CONDENSER PIPING



PIPING DIAGRAM WITH EQUALIZING LINES FOR MULTIPLE COMPRESSOR AND CONDENSER SYSTEM WHEN CONDENSERS ARE LOCATED BELOW THE COMPRESSORS



PIPING DIAGRAM WITH EQUALIZING LINES FOR MULTIPLE COMPRESSOR AND CONDENSER SYSTEM WHEN CONDENSERS ARE LOCATED ABOVE THE COMPRESSORS

Drawings on This and Reverse Page, Courtesy of Worthington Corp., Harrison, N. J.

NDHA Convention Hears Technical Papers on

More Efficient Steam Operation

A. F. METZGER

Superintendent of Steam Utilization, Allegheny County Steam Heating Co., Pittsburgh, Pa.

Abstracts of some of the many papers presented at the annual meeting of the National District Heating Association which was held on June 1 to 4.

THE 1959 convention of the National District Heating Association was a noteworthy one. Fifty years ago this association was founded, and its golden anniversary was celebrated at the annual meeting which was held at the Skytop Club, Skytop, Pa., June 1 to 4. At the convention dinner, tribute was paid to the 14 past presidents who were present.

Officers elected for the coming year are: G. F. Prestwich, president; A. F. Metzger, 1st vice president; J. D. Lemon, 2nd vice president; J. C. Thompson, 3rd vice president; J. F. Collings, Jr., secretary-treasurer; and R. H. Swoyer, D. H. Brandt, and E. T. Smith, directors.

Rapid Corrosion Evaluation

P. R. Puckorius, Nalco Chemical Company, Chicago, described a recently developed method for rapidly evaluating corrosion in piping systems. Heretofore, corrosion was usually evaluated by placing coupons or specimens of the major metals of the system in the fluid stream and measuring their weight loss after long periods of time. In addition to the long periods of time required, errors could be effected in cleaning the specimens before weighing. The method described uses probes of thin ribbon, fine wire, or thin wall tubing of the major metal of the system. The probes are meticulously cleaned and sand blasted before insertion in the fluid stream. A second specimen of the same material, protected from the corrosive action of the fluid, is placed on the probe support near the exposed specimen as a reference. The electrical resistance of both specimens is measured after insertion. As corrosion takes place, the specimen becomes thinner and its electrical resistance increases. From this increase it is possible to calculate the loss of metal from corrosion. The protected specimen is used as a reference to check for changes in the electric testing circuit resistance.

The electrical resistance method of testing corrosion in the laboratory can detect decreases in metal thickness as low as 5×10^{-8} inches. While the probes used in the field must be more rugged and less sensitive, it is still not unusual to detect thickness losses as low as 2×10^{-7} inches. Assuming the latter limit of sensitivity, a corrosion rate of .005 IPY (inches per year) can be detected from measurements taken only a few hours apart. A special resistance measuring instrument called a corrosometer has been developed which gives readings directly in microinches of corrosion.

With this system of corrosion evaluation, studies of corrosion and the effects of inhibitors can be made in the field in days instead of months or years as with former systems.

Ion Exchange Process for Boiler Water

I. B. Dick, Consolidated Edison Company, New York City, gave a very comprehensive paper on the feasibility of the ion exchange process of water treatment for high make-up plants. He explained that high make-up was anything over 3%. He arbitrarily divided water treatment for high make-up boilers into two parts: Treatment for low pressure boilers and treatment for high pressure boilers where, for the purpose of his discussion, he used 600 psi as the dividing line between low and high pressure.

It was explained that the conventional water treatment process for high make-up, low pressure boilers, was the addition of some sort of alkaline phosphate, usually in combination with an excess of alkalinity. This process, when properly used, produces good results, permitting satisfactory boiler cleanliness with a moderate maintenance program.

In describing the ion exchange process of water treatment, it was explained that all natural fresh waters contain some chemicals in solution, the nature and amount varying, depending on local geological conditions. Most of the chemicals in the water are ionized (electrically charged) and this feature is taken advantage of in removing them by the ion exchange process. The undesirable materials which cause scale in boilers are calcium and magnesium, known as the "hardness" components.

The ion exchange process utilizes zeolites to bring about the exchange. Two principal types of zeolite are used: (1) the sodium zeolite and (2), the hydrogen zeolite. When fresh water is passed through a bed of zeolite particles, the sodium in the sodium zeolite has less attraction than calcium or magnesium, therefore, calcium and magnesium zeolites are formed and sodium compounds left in the water. In the process, the "hardness" nature is removed. With the hydrogen zeolite process, all ionized materials are removed and only water and chemicals which do not ionize remain. Silica is one of the unwanted chemicals which appears to some degree in a non-ionized state.

The use of the ion exchange process is a matter of economics. Usually the investment in equipment is higher than for the chemical treatment equipment. On the other

hand, the operating costs may be lower, but there are other benefits which have an economic value.

The sodium zeolite system is perhaps the easiest to justify economically but it is not suitable for high pressure boilers supplying steam to turbines because it does not remove the non-ionized silica.

In conclusion, the author stated that, based on factors existing in his company's area, external water softening by ion exchange is practical and economical in a new boiler installation but economically questionable if installed in an existing plant. For high pressure, high make-up plants, deionization is necessary which requires the hydrogen zeolite system or a combination of the hydrogen and sodium systems. This treatment was also shown to be economically justifiable even though the first cost and operating cost are higher.

Automatic Ejection of Water from Manholes

Marvin R. Lewis, Detroit Edison Company, described a device for automatically operating a steam jet water ejector in one of his company's deep tunnel sumps. The device was suggested by rough sketches of an employee in the Underground Lines Department after taking a company course in work simplification. A system of levers and sliding weights operated by a float operate a quick opening, steam piston-operated valve controlling the steam to the ejector. The device is shown in Fig. 1. The unit, which was placed in operation, is saving approximately $1,300 per year in labor alone. Furthermore, it is less costly than motor operated valves and more suitable for high temperature locations. Steam for power is more readily available than electric service in tunnels or manholes.

Dynamically Balanced Diaphragm Valve

Henry W. Angelery, Aerco Corp., Northvale, N. J., described a new dynamically balanced diaphragm valve, developed by his company, to accurately modulate steam flow to its limited storage capacity steam water heater. The valve is single seated but is ingeniously designed to be balanced over a wide range by the steam flow forces of impulse, reaction and aspiration. The main valve is initially opened by balancing static pressure above and below the main valve plug, through the use of an inner port stroked by the main stem before the main valve is stroked open. After the main valve is open, the dynamic forces of the steam due to the configuration of the main plug and valve body maintain balanced conditions so that the diaphragm forces act only against the fixed forces of the stem and main plug springs.

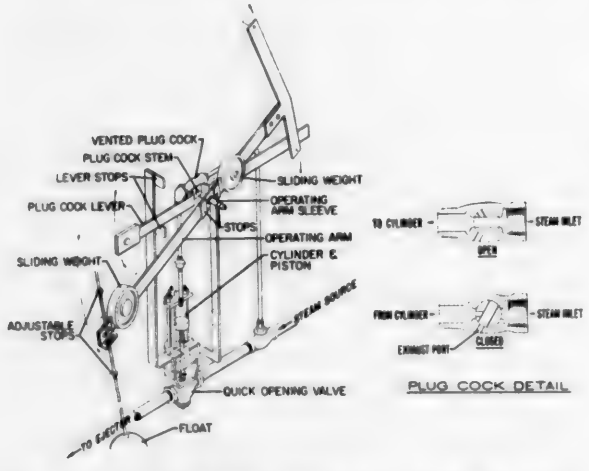


Fig. 1. Automatic steam control valve for sump ejector.

Heating Post War Buildings

Robert E. Bohonan, Consolidated Edison Company, New York City, presented a paper intended to show the effect of modern building design and construction on the steam requirements for heating. He stated that more than 100 office and commercial buildings within reach of his company's district steam distribution system have been built within the last decade. Practically all of these buildings have all season heating and cooling systems which control both temperature and humidity. Their total rentable area amounts to some 31,000,000 sq ft. The author selected ten of these buildings, all of which use purchased steam, to study their heating requirement. These buildings range in size from 1,400,000 cu ft of cubical content to 6,300,000 cu ft. While a great many apartment buildings were constructed during the same period, none were selected for study because those features of these buildings affecting heat gains or losses have not materially changed during the years.

The average rate of steam consumption to heat the 10 buildings studied over a 5-year period was 570 lb per 1000 cu ft degree-day. The rates for the individual buildings were from 0.387 to 0.865 lb per 1000 cu ft per DD, however, the rates for five of the buildings were quite similar. The type of occupancy and the hours use of the buildings could account for some of the differences. The new building average factor of 0.570 lb per 1000 cu ft per DD compares with 0.700 lb per 1000 cu ft per DD for the older buildings.

While the author of the paper believes that new type construction, where brick and masonry were replaced with curtain walls of steel or aluminum with glass, marble or enameled inserts, and the use of insulation may have accounted for some of the decrease in steam use, he is also of the opinion that a large part is due to a steady release of internal heat of appreciable magnitude from various sources. The higher intensity lighting is one factor amounting to 2 to 5 watts per sq ft as compared to ½ to 1½ watts per sq ft in older buildings. In the newer building, less space is allocated to each employee which means more employees and more body heat. Heat from business machines must also be recognized.

Loss from infiltration of air is greatly decreased due to tighter windows and controlled mechanical ventilation.

Greater window areas in the new buildings would indicate greater transmission loss, but the insulation due to double glazing and the greater amount of solar heat transmitted appear to result in a net heat gain.

All the aforementioned factors, when combined with ideal zoning, in the opinion of the author, readily account for the heating factors developed.

Trends in the Sale of District Steam

William C. Kaber, Union Electric Company, St. Louis, Mo., summarized a survey made of 51 steam utilities to determine the trends in the sale and use of district steam. The report had many encouraging items. In 37

cities, 355 new customers were added with an estimated annual steam consumption of 2,917,539 M pounds and an estimated annual revenue of $3,991,665. The average revenue of all new business is $1.37 per 1000 pounds. Of the new customers 24% had used district steam before, 42% are in old buildings using steam for the first time, and 34% are in new buildings. In 25 cities, 113 existing customers added a load estimated to return an annual revenue of $399,481.

On the loss side, 50 customers in 18 cities discontinued steam service; 70% of those lost converted their systems to use gas. The loss in revenue was $223,531 per year.

The report included many other interesting figures and comparisons.

Snow Melting Experience in Boston

Frank C. Meyer, Boston Edison Company, presented a paper decribing the steam department's experience in melting snow on the inclined ramps leading onto and off the elevated expressway through Boston. The paper reported that in planning the express highway, it was recognized that the inclined ramps would present a traffic hazard during snow storms or after freezing rains. To prevent this hazard, it was decided early that snow melting systems would be installed in the surfacing concrete.

Because the snow melting maximum demand would occur during the Edison Company's electric system peak and the annual load factor would be in the order of 2½%, the economics of an electric snow melting system would not have been feasible. A steam heated system using district steam to heat an antifreeze solution was considered next. The load factor was no better but it was found that the peaks of the snow melting system and the steam system would not be coincident because snow seldom falls in Boston below 15 deg F. However, it was questionable if the load could be taken on a firm capacity basis.

The contract for steam service was finally resolved on the basis that steam would be served on an interruptible basis, with the Commonwealth assuming the cost of distribution piping to fourteen ramps from three service points and that steam would be charged under the Edison Company's general rate.

The total snow melting area of the fourteen ramps was 108,800 sq ft. On the basis of 400 Btu per sq ft and approximately 5% line loss, the maximum steam demand was estimated to be 45,000 pounds per hour.

The system has been in use three years, with the following results:

Year	*Snowfall Inches*	*Steam Steam Consumption, 1000 Lb*	*Lb Steam/Inch Snow/Sq Ft*
1956	72	13,207	1.84
1957	36	7,355	2.04
1958	49	7,728	1.57

After two years operation, the manual operating schedule was revised which resulted in a substantial reduction in steam use as indicated in the above tabulation. However, compared to the rate of use for sidewalk snow melting, the rate of 1.57 is still high. One large sidewalk system in Boston has a consistent rate of use of 1.05 lb per inch of snow per sq ft.

Wide Range Steam Metering System

W. G. Gillim, Consolidated Edison Company, New York City, in his paper, stated that until such time as steam flow meters are available which will meter accurately wide ranges of flow, multiple meters with electrical switching and motor operated valves offer a satisfactory method of metering steam consumption of the latest type of large office buildings.

Because of the character of the steam flow in new buildings and the need for maximum pressure at the utilization equipment, metering of steam in New York is becoming more and more exacting. The accepted practice of locating meters as close to the service entry point as practicable, coupled with the diverse character of steam usage, results in the necessity for an installation with metering ranges of 30:1 or greater. The second consideration of low pressure drop precludes the use of high pressure drop meters and sequential meter operation by means of pressure-reducing valves which heretofore had proved satisfactory. To get the desired results, three flow meters were used in parallel. In this system the first meter, which is in continuous operation, records the base load. The second meter which has three times the capacity of the first, is turned on and off by means of a motor operated globe valve located downstream from the metering orifice. That valve is controlled by the position of the first meter pen arm. The third meter, which has three times the capacity of the other two combined, is likewise turned on and off by means of a motor operated globe valve located downstream from its orifice, and is controlled by the pen arm of the second meter. The meters used are Bailey, Type CC 3651, 53-inch differential meter equipped with two magnetic Mercoid switches.

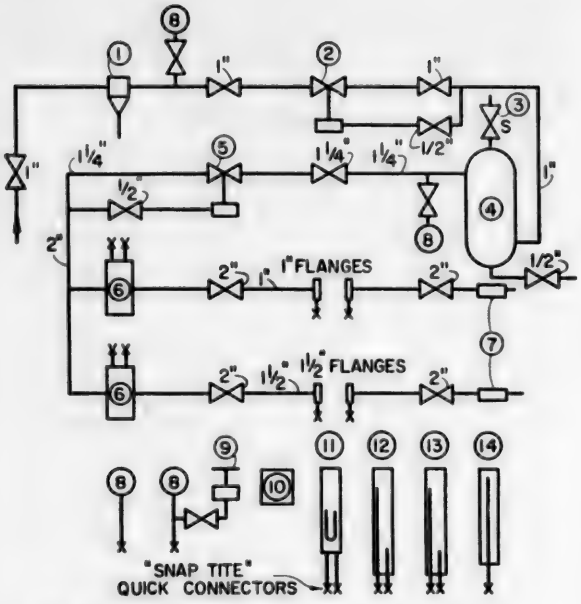
The arrangement of meters as described gives a ratio of 1:3:12 and an overall range of 36:1.

An evaluation shows that the cost of such an installation varies from 11 to 16% of the annual revenue. It can, therefore, be seen that in very large buildings, if metering losses are reduced by, say, 3% per year, the gain in revenue would recapture the installation cost in a period of five years.

Critical Flow Orifice Testing of Flow Meters

James W. Althouse, Jr., Philadelphia Electric Company, presented a paper describing a flow meter test station installed by his company's meter division for testing shunt meters. This station incorporates two important features which facilitate the testing of steam meters. One is the use of air instead of steam for test purposes and the other is the use of critical flow orifices. He explained that critical flow orifices are precisely machined orifice nozzles with well rounded entries which have the characteristic that a constant time is required to pass a given volume of air through them, measured at inlet conditions, provided that the absolute inlet pressure is more than twice the absolute outlet pressure. A schematic diagram of the test station hookup is shown in Fig. 2.

The test station includes equipment for a steady flow



1. Trap filter
2. Auto reducer
3. Safety
4. Reservoir, 16 cu ft, 150 psi
5. Auto reducer
6. Standard orifice
7. Silencer
8. Pressure gage
9. Dead weight gage
10. Electric timer
11. Manometer, 20-inch H_2O
12. Manometer, 100-inch Hg
13. Manometer, 100-inch H_2O
14. Absolute pressure gage

Fig. 2. Schematic diagram of Philadelphia Electric Company flowmeter test station.

of air from a 90 psi source to the two test circuits. Each test circuit includes a critical flow orifice fitting, meter flanges and exhaust silencers. Bourdon pressure gages, dead weight gage, and mercury manometers equipped with "Snap Tite" quick connectors are mounted on the front panel for use where needed to determine pressure. The front panel also contains an electric clock and a mercury barometer.

The heart of the station is the Robinson Type *H* quick change orifice fittings which allow rapid change of standard critical orifices during a test run. Standard orifices have been designed for the various volumetric flows needed for testing the various size meters for heavy and light flow.

In testing, a meter is placed between the meter flanges and the proper size standard orifice for heavy flow is placed in the orifice fitting. Then the proper air pressure is established ahead of the test orifice. The meters being tested are shunt meters with sweep hands on the register which revolve one revolution in one minute at 100% of rated capacity. In testing the meters, after air flow is stabilized, the operator determines the time in seconds for one revolution of the sweep hand. During the run he reads the air pressure ahead of the test orifice, the pressure ahead of the meter being tested, the barometric pressure, in addition to the time. A second run is made at light load by changing to a smaller standard orifice. From the orifice constant and the readings taken, the meter multiplier is directly calculated by the formula: Multiplier equals meter constant times seconds for one revolution of sweep hand times absolute pressure of air at test orifice inlet in inches of mercury, divided by the square root of the absolute pressure (inches Hg) ahead of the meter. The average of the calculated multipliers for the heavy and light flows can be compared to the multiplier on the meter to determine its accuracy in per cent.

The testing station has been found to produce accurate results with considerable savings compared with test methods using steam as a testing medium.

High Temperature Water System for U. S. Air Force Academy

E. G. Hansen, Midland-Ross Corp., New York City, reported on the design and installation of the high temperature hot water heating system for the U. S. Air Force Academy at Colorado Springs, Col. Mr. Hansen described the topography of the site and the type of buildings requiring heating service. After carefully studying various fuels available, the merits of individual heating plants vs. central plants, steam vs. hot water and other choices, it was decided that the individual houses in the housing area should be heated with residential gas heating systems and that the other areas should be heated by two high temperature hot water central heating systems using gas firing for the generators. This selection was the result of an economic study which showed the hot water systems would require the least investment and operating cost. While there are two central systems, the one for the services and air field area was only described briefly because its operating principles and general plant disposition are similar to those of the main system.

The main system has a capacity of 400,000,000 Btu per hour with initially installed boiler capacity of 300,000,000 Btu per hr. The distance of water travel to the farthest user and back is from 6¾ to 7 miles. The highest point on the system is 250 ft above the boiler house floor and the lowest point 250 below. The HTW is used only as a heat carrying medium from the plant to heat exchangers in the various buildings.

The distribution system is zoned; 430 deg water is sent to the Academic Area and Hospital above the boiler house location and 450 deg to the community Center Area and others below the boiler house. A design entering temperature at all buildings is 440 deg and a design drop of 200 deg was used for the heating and domestic hot water loads. The user leaving hot water temperature is 240 deg. Where steam is required a drop of 100 deg was allowed.

The maximum HTW pressure at the lowest point is 705 psig which is 55 psi below the maximum allowable working pressure for pipes and fittings.

Forced circulation boilers were selected; they are once-through water heaters without internal circulation and without drums, depending on pumps to force the water through them. The expansion and contraction of the water volume in the system is absorbed in the expansion tank in which a pressure cushion of steam is maintained above the water line. The steam for the expansion tank cushion is flash steam produced by the boilers in heating up the water. Each of the present three boilers has a capacity of 100,000,000 Btu per hr when heating 517,000 lb of water per hour, or approximately 1150 gpm, from 272 to 454 deg, discharging into a common

expansion tank. A separate boiler circulating system with as many pumps as there are boilers plus one standby, assures a constant flow in the outside mains. Each pump has a capacity of 1150 gpm with a 90 ft total dynamic head and is equipped with a 40 hp motor.

Two groups of pumps, one for the high level circuit and the other for the low level circuit, independently circulate the water through the distribution mains. Each group takes separate suction from the expansion tank. The returns from both circuits are brought together and introduced into the boiler recirculating pump suction line. Thus, the boiler recirculating system receives its water preferentially from the distribution system and takes from the expansion tank only the difference required to make up the full circulating capacity. Mr. Hansen described many other interesting features of the heating system.

Induction Welding of Pipe

J. Bogdanowski, Consolidated Edison Company, New York City, ably described and illustrated with a colored motion picture, his company's adventure into mechanization of pipe line welding. He told how, in the face of the advances in the mechanization of manufacturing processes and the great progress in welded pipe line construction, welding still remains in the category of manual arts. This results in a shortage of good qualified welders and an increase in the cost of welding labor.

To overcome some of the disadvantages of manual welding, the company investigated various methods for mechanized welding. The electric induction method was selected and power equipment was purchased. Company personnel designed and constructed the field jigs and associated pipe handling and aligning equipment. Several hundred experimental welds were made before the machine was put to use.

In the field application, the mechanized induction welding technique calls for square butt preparation of the pipe ends, which must be cleaned of all foreign matter, preferably by cutting or filing. The butt ends are then placed end to end in a straight line alignment and subject to an interface pressure of 1500 psi by a hydraulic system. The joint circumference is then enveloped by a one turn electric induction coil, which when energized induces 9600 cycle currents in the pipe causing it to heat up to 2500 deg. At this temperature a motion of the metal ensues in the area of the interfaces causing the pipe to weld and the pipe ends to upset to a predetermined height. At this point, the machine unit shuts off power to the induction coil. During the welding operation, an inner and outer barrier of inert Argon gas is impressed to prevent oxidation. The total time of the heat cycle is 75 to 80 seconds per weld. The power input is approximately 8 kw per square inch of the pipe end face area.

After welding some four miles of pipe in the field, Consolidated Edison Company found mechanized welding to be economical. The problem now is to find more efficient means of pipe handling for the process.

Positive Discharge Coal Bins

James R. Garvey, Bituminous Coal Research, Inc., Columbus, Ohio, reported on progress made in developing a discharge for coal or other similar bulk materials from bins without the stoppages frequently encountered.

The author of the report described a test bin which was made for the laboratory. The bin was 3 ft in diameter and 4 ft high with truncated conical bottom sections with various slope angles. Coal was conveyed to and from the bin and its flow through the bin studied.

It was concluded from the tests that poor flow performance was due to the presence of a central core movement which causes ratholes and high pressures and coal adhesion to the hopper walls. It appeared that this core movement must be controlled to get improved flow. This resulted in the insertion of plates and cones inside the bin discharge.

Overfire Jets Help Smoke Abatement

Smoke ordinances and overfire jets are hoary with age. The first use of jets to abate objectionable smoke was made in England. The device was patented by M. W. Ivison in 1838. Since that time patent applications have run into the hundreds, each patentee claiming superiority over the others, but without test or accurate performance data to support his claim.

There are probably few industrial plants in cities having smoke ordinances that have not either used some form of crude steam-air jet or been approached by someone with a patent, often guaranteeing a ridiculous saving in fuel as well as eliminating smoke. Results were usually disappointing, giving the steam-air jet a poor reputation. When properly applied and its limitations recognized, the steam-air jet can do a creditable job.

Study Firms up Design

Strangely enough, in spite of years of use, little was known about optimum design standards for the jet or its application until 1943 when Bituminous Coal Research, Inc., undertook an investigation of the steam-air jet. This investigation developed the correct values of some hitherto uncertain design features: (1) effect of nozzle location in reference to the air tube; (2) relation of nozzle diameter to air tube diameter; (3) entrainment ratio as related to steam pressure, nozzle diameter and air tube diameter; (4) the noise level of open jets, which is particularly objectionable and prompted an investigation of silencer design that would satisfactorily silence the jet without impairing its air capacity; (5) jet velocity required to give adequate mixing of furnace gases and furnace penetration.

Four-Point Program for Jets

A satisfactory jet installation is dependent on four important considerations: (1) complete furnace coverage (area), (2) height of jet above the fuel bed, (3) adequate penetration, and (4) quantity of overfire air.

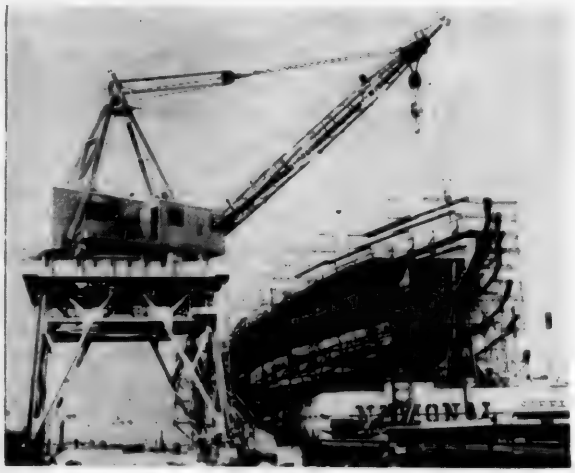
Each of these items is covered completely in the BCR Aid to Industry 500-300, "Application of Overfire Jets to Prevent Smoke from Stationary Plants", announces Bituminous Coal Institute, 802 Southern Bldg., Washington 5, D.C.

◀ When the *N.S. Savannah*, world's first nuclear-powered merchant ship, puts to sea next year, she will get her "go power" from pressurized water type atomic reactors. But for heating, the ship will rely upon a more conventional system — Trane Maritime Convectors.

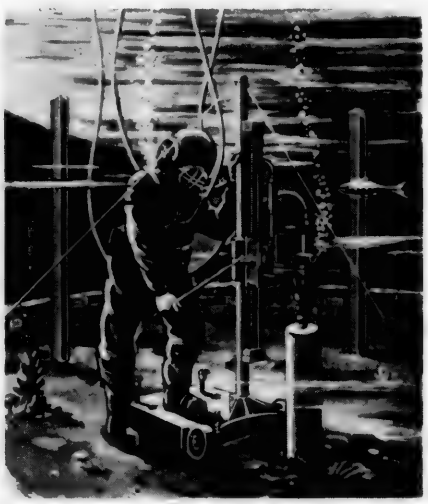
Picture Paragraphs

on matters marine

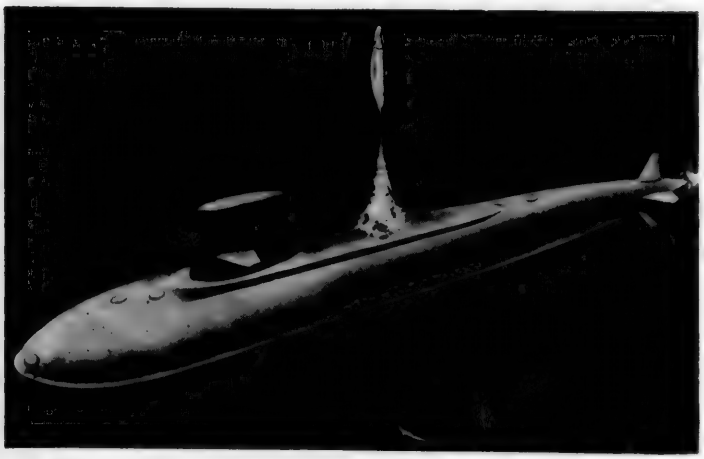
▲ A mammoth, yet flexible, winter-summer comfort conditioning system, using Marlo air conditioning and heating coils, permits individual regulation of temperatures in each stateroom and suite of the *Santa Rosa*, Grace Line's new luxury liner.



▲ A $5.6-million coast and geodetic survey ship, designed for survey work in arctic and tropical waters for the Department of Commerce, is being built at National Steel and Shipbuilding Corp.'s San Diego yard. To fill fresh water requirements of ship and personnel, Cleaver-Brooks will provide a 2-stage flash evaporator which will convert sea water to potable water at the rate of 8000 gallons each day.



▲ For the first time in the history of marine construction, divers working in 65 ft of turbulent water recently bored deep holes in granite bedrock to secure foundations for two dolphin piers at Canada's Texada Island. Truco portable drilling equipment did the job — ten holes of 8-inch dia to 5-ft depth — to within one inch of specifications.



◀ Five atom-powered subs now being built for the U.S. Navy can launch Polaris missiles with a nuclear warhead while under water and concealed from detection. Each undersea ship will use Carrier equipment to provide habitable atmosphere for its 10 officers and 90 crewmen.

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

Pressure Reducing Valves

AN abundant supply of clean water is necessary for every new building being erected. This is considered an essential.

When the water pressure is inadequate to serve the needs of all the fixtures in the building, the engineer must employ one of several methods that will provide adequate pressure. The several methods that can be utilized to increase the water pressure are booster pumps, hydro-pneumatic water system, and roof tanks.

The opposite of inadequate pressure is excessive pressure. When this condition is encountered, the engineer must take the proper steps to reduce the pressure to a prescribed limit best suited for the building needs.

Effects of Excessive Pressure

Excessive pressure in a water distribution system causes a number of disturbing factors in addition to harmful effects on the piping.

A water distribution system with an excessive pressure is a noisy system. The passage of water through the piping will generate noises, especially at piping offsets. As the water passes through small diameter pipe, the noise that is associated with its movement is quite audible. Stresses are set up in the pipe and fittings and these can be damaging to the piping. Furthermore, since piping will tend to move with the velocity of the water, a strain is imposed upon piping supports and hangers.

Due to the abrasive action of water under pressure, valves, faucets and equipment served will also suffer. Faucet washers will require more frequent replacement. The innards of gate and globe valves tend to vibrate with the surging of the water. Delicate equipment served by the water supply can rupture as a result of excessive pressure.

Hydrostatic shocks of an intensified nature are always associated with excessive water pressures. Thus, piping will rattle and bang to an annoying extent, and the pressure exerted in the line due to the quick closing of a valve or faucet can actually rupture the pipe. Therefore, a water distribution system with excessive pressure is as dangerous as a system with inadequate water pressure. Moreover, systems with excessive pressures waste considerable quantities of water.

Control of Excessive Water Pressures

It is rather difficult for a community to regulate the water pressure in the exterior piping distribution system. In fact, the water pressure will vary in all parts of the community with the result that some sections of the community will have excessive pressures while other sections will have just sufficient pressure. This practice is necessary to ensure that the overall area will obtain adequate pressure. When the community water system serves buildings in addition to fire hydrants, it becomes extremely important that a sufficient pressure be maintained.

When an engineer finds that the street water pressure is excessive for a contemplated water distribution system in a building, he must consider means that will reduce and maintain a prescribed pressure for his proposed system. This is accomplished by the use of pressure reducing valves.

Pressure Reducing Valves

There are many types of pressure reducing valves available. Although the basic operation of all the valves

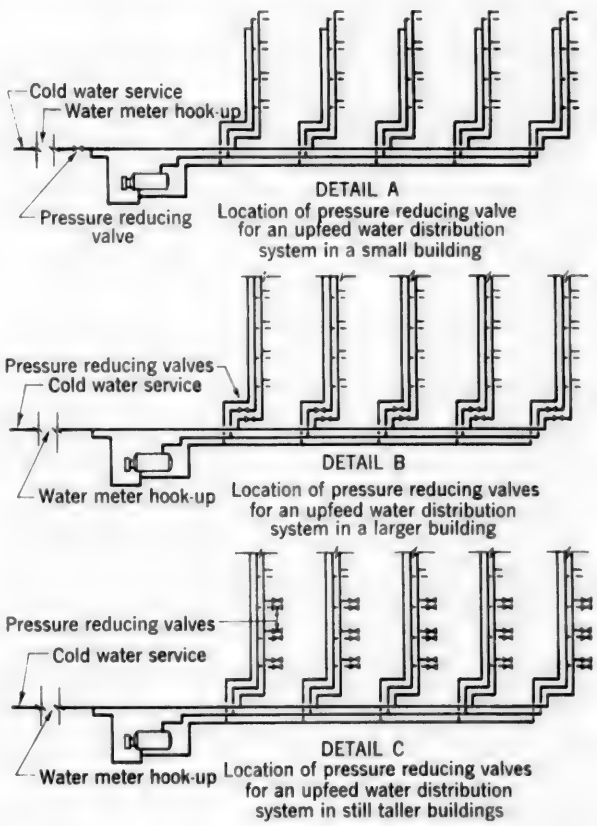

Cold water service
Water meter hook-up
Pressure reducing valve
DETAIL A
Location of pressure reducing valve for an upfeed water distribution system in a small building
Pressure reducing valves
Cold water service
Water meter hook-up
DETAIL B
Location of pressure reducing valves for an upfeed water distribution system in a larger building
Pressure reducing valves
Cold water service
Water meter hook-up
DETAIL C
Location of pressure reducing valves for an upfeed water distribution system in still taller buildings

Fig. 1. Locations where pressure reducing valves may be used to reduce and maintain prescribed water pressures.

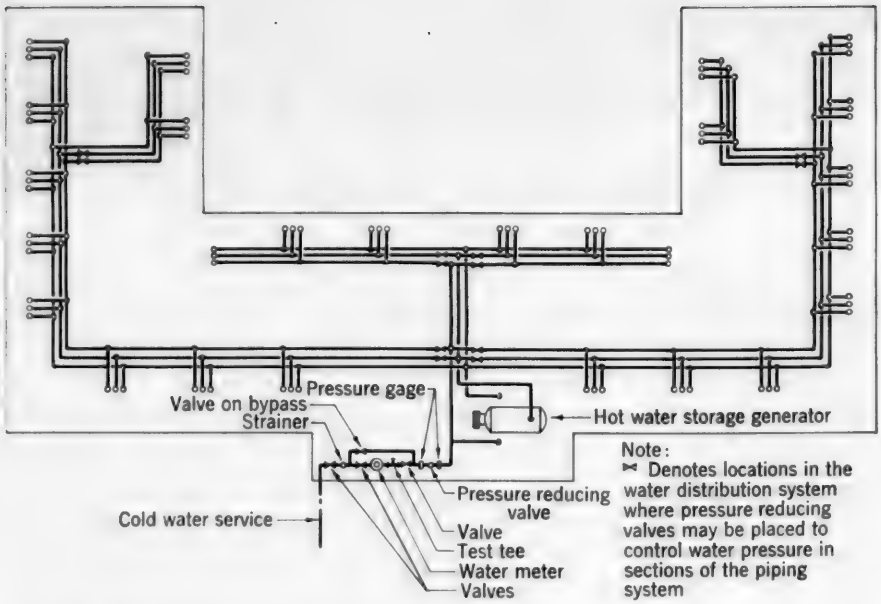

Pressure gage
Valve on bypass
Strainer
Hot water storage generator
Note:
⋈ Denotes locations in the water distribution system where pressure reducing valves may be placed to control water pressure in sections of the piping system
Pressure reducing valve
Cold water service
Valve
Test tee
Water meter
Valves

Fig. 2. Suggested arrangement of a water distribution system in a building, indicating where pressure reducing valves may be located.

is rather similar, certain features incorporated in each design distinguishes the different valve types. In general, a valve can be selected that will handle any specific need in a water distribution system.

When a problem arises concerning excessive water pressures, a valve manufacturer should be consulted so that he can assist in the proper valve selection.

Location of Pressure Reducing Valves

Where should pressure reducing valves be placed on a water distribution system to be most effective? Figure 1 offers three basic suggestions.

Detail *A* represents a four-story building. If the water pressure serving this building is excessive, it can be controlled by placing a pressure reducing valve on the house side of the water meter hook-up as shown. In this manner, it is possible to reduce an excessive water pressure to one that is adequate to serve fixtures at the top floor level.

When the building is taller, it may be advisable to locate pressure reducing valves at the base of the cold and hot water risers as shown in Detail *B*. This method provides a flexible control arrangement and allows each riser to be adjusted to a pressure that is best suited for the different types of fixtures served by each set of risers.

For still taller buildings, utilizing an up-feed system of piping, it may be advantageous to locate pressure reducing valves on the water branches serving the first few floors of fixtures as shown in Detail *C*. This method will handle the excessive water pressures at the first few floors and will allow the upper floors to be served by street water pressure without any pressure reduction.

In all three details, none of the valves and controls normally included in the system have been shown. Only the pressure reducing valves have been indicated for the sake of clarity in pinpointing suggested installation locations.

Basement Mains

Figure 2 shows a general arrangement of piping for an up-feed system in a building and denotes where pressure reducing valves can be placed to best serve the different sections of piping.

The building of Fig. 2 is a large one. Illustrated are the different locations where pressure reducing valves can be placed. A reducing valve has been placed on the cold water service main in the building, on the house side of the water meter hook-up. This would be the desired location if the entire water distribution system were to be controlled at this point.

A pressure gage has been placed on either side of the reducing valve to permit an accurate adjustment of the reduced pressure. If it is not desired to place the valve at this location, then the valves may be placed at alternate locations as suggested in Figure 2 to control the different sections of piping. Each proposed design requires particular study by the engineer to best satisfy the needs of the building.

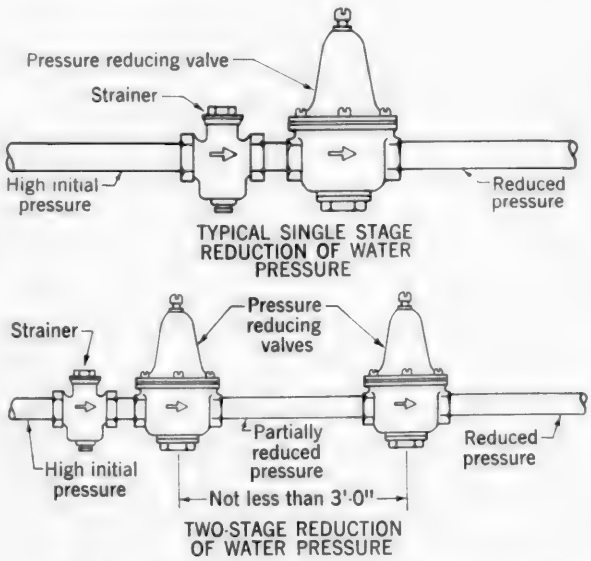


Fig. 3. Two methods for water pressure reduction.

Special Conditions

Sometimes, conditions of excessive pressure are encountered in a building which require that special consideration be given to the installation of a pressure reducing valve. Figure 3 shows how extremely high pressures can be controlled.

It shows a single stage reduction of water pressure; this arrangement consists of a strainer and a pressure reducing valve. If the water pressure is abnormally high, this arrangement may not be sufficient since there will be considerable wear and tear on the operating parts of the valve. Therefore, another method of reduction is advisable.

Figure 3 also shows how a two-stage reduction of water pressure can be accomplished. This arrangement consists of a strainer and two pressure reducing valves. The first valve reduces the abnormally high water pressure to a moderate degree and then the second valve further reduces the pressure to a limit best suited for the needs of the building.

Other arrangements can be employed for specific conditions but it is suggested that you consult the manufacturer of the particular valve favored for his recommendations.

Tall Buildings

In tall buildings down-feed distribution systems are generally installed. A typical example of this type system is shown in Fig. 4.

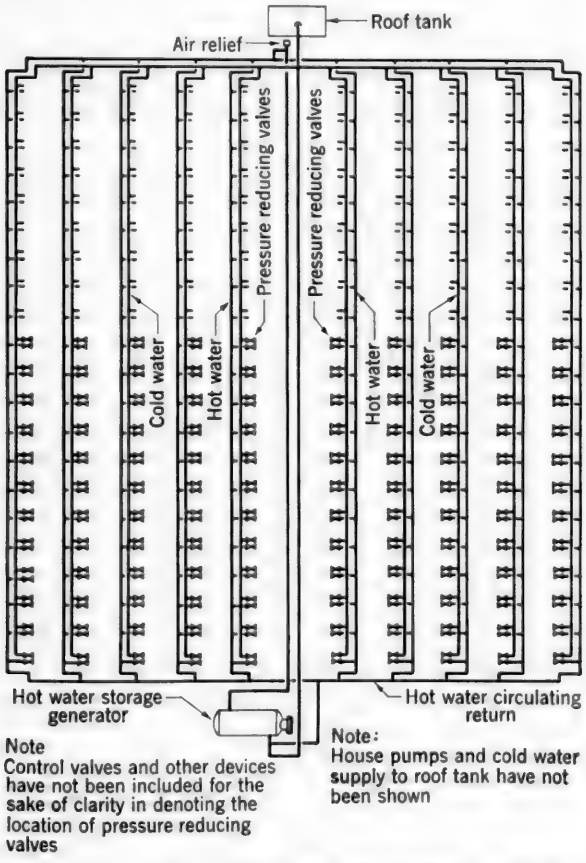

Roof tank
Air relief
Pressure reducing valves
Pressure reducing valves
Cold water
Hot water
Hot water
Cold water
Hot water storage generator
Hot water circulating return
Note
Control valves and other devices have not been included for the sake of clarity in denoting the location of pressure reducing valves
Note:
House pumps and cold water supply to roof tank have not been shown

Fig. 4. A typical downfeed water distribution system in a tall building. Pressure reducing valve locations are shown.

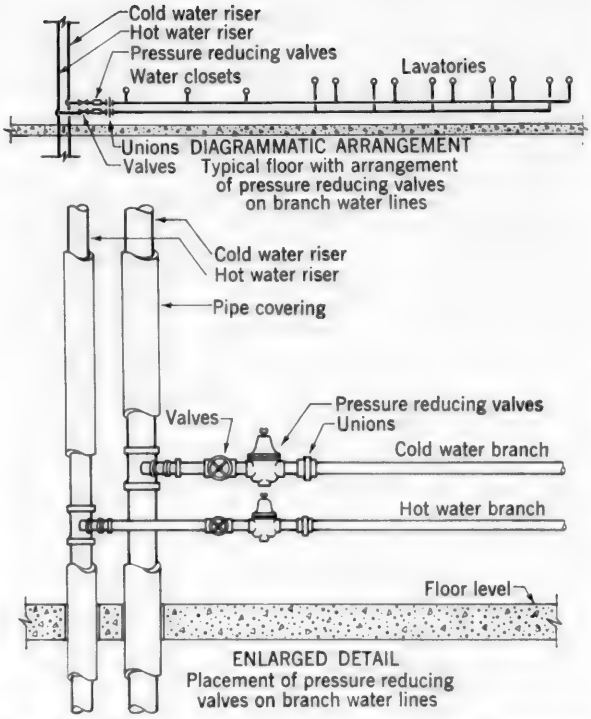


Fig. 5. How pressure reducing valves are placed on branch water lines which serve a battery of fixtures.

In this design, the roof tank is set at an elevation that will supply the needed water pressure for the upper stories of the building. However, with this type of system, the water pressure for the lower floors will increase to an excessive degree, due to the height of the piping. Therefore, it is necessary to install pressure reducing valves on branches to the fixtures at the lower floors as shown in Fig. 4. The valves are placed on the cold and hot water branches at the lower floors where the water pressure exceeds a prescribed limit. Other methods of reducing the pressure in a down-feed system may also be utilized.

Cold and Hot Water Branches

Pressure reduction on typical cold and hot water branches is detailed in Fig. 5. The small diagrammatic arrangement shows how the branches serve a battery of fixtures, consisting of water closets and lavatories. The enlarged detail shows a placement of the pressure reducing valves to provide a regulated pressure to the fixtures. This same arrangement is typical for the pressure reducing valves shown in Detail *C* of Fig. 1.

Types of Pressure Reducing Valves

Many types of pressure reducing valves are available. A few of the different types produced by one manufacturer are detailed in Fig. 6.

It is impossible to cover the entire field of pressure reducing valves in one short article and it is for this reason alone that only one manufactured type was selected for example. However, other manufacturers will furnish similar information on their products.

A illustrates a small type of reducing valve that can be placed on supply lines to drinking fountains, kitchen equipment, laboratory equipment, distilled water pro-

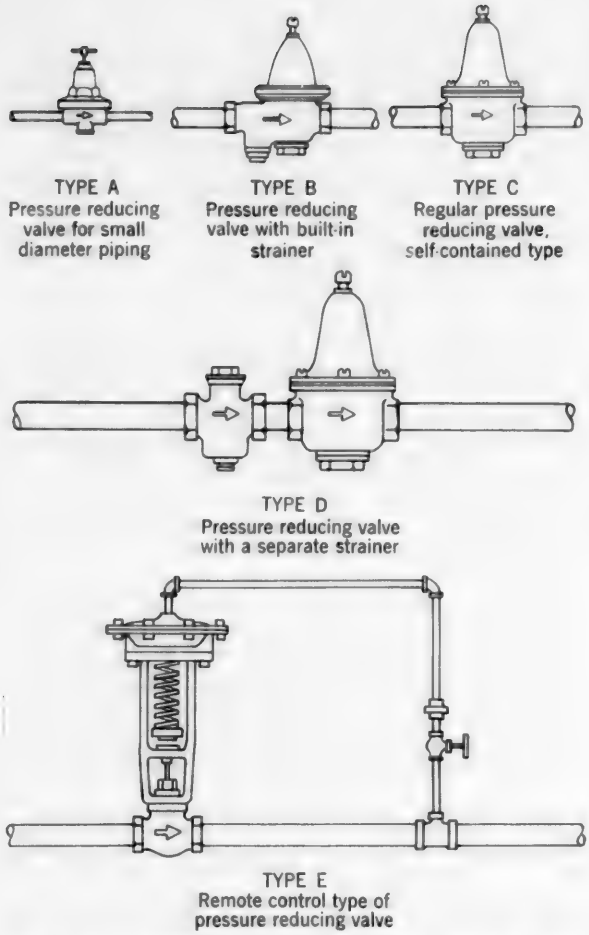

TYPE A
Pressure reducing valve for small diameter piping
TYPE B
Pressure reducing valve with built-in strainer
TYPE C
Regular pressure reducing valve, self-contained type
TYPE D
Pressure reducing valve with a separate strainer
TYPE E
Remote control type of pressure reducing valve

Fig. 6. Several different types of pressure reducing valves produced by one manufacturer.

ducers, and many other types of apparatus where a regulated water supply is needed.

B shows a pressure reducing valve with a built-in strainer. Strainers are a necessity since they protect the valve from grit and foreign objects that could damage the working parts.

C shows the type valve that is most popular in application. This particular valve has been used in many of the illustrations in this article.

D is the same reducing valve with the exception that a separate strainer is placed in front of the valve.

E is the type valve employed when it is desired to maintain very accurately controlled pressures. The valve is a remote control type.

Operation

Pressure reducing valves are of two basic types: (1) the self contained type, and (2) the remote control type. The remote control type is shown in Type *E* of Fig. 6. The self-contained type is illustrated in Fig. 7. All the working parts are labeled and following is the operation of the valve.

With the spring under compression, the valve is normally open, therefore the diaphragm is deflected downward since there is no pressure under the diaphragm to oppose it. With water pressure in the system, a force greater than that exerted by the spring will deflect the diaphragm upward. With no flow from the fixtures, the pressure will increase, deflecting the diaphragm until it completely closes the valve.

When a fixture faucet is opened, a drop in water pressure results, the valve senses this action and immediately acts to increase the water flow and maintain the prescribed pressure. The diaphragm is deflected and the valve starts to open enough to pass water at the same rate at which it is flowing through the faucet. Thus the valve will open or close to permit the flow of water at the prescribed pressure required for the fixtures. The desired pressure is attained through the tension imposed upon the spring by means of the adjusting screw on top of the valve.

A valve of this type will vary as much as 15 or 20 pounds depending upon the capacity of the valve being used and the amount of water demanded at the fixtures.

Capacity and Sizing of Pressure Reducing Valves

The capacity of a pressure reducing valve is usually shown as the maximum flow obtained through the valve when it is wide open and when varying pressures are maintained by the incoming and outgoing pressure at the valve connections. This is not a realistic rating and should be used only for comparison of the various types and makes of valves.

The capacity to use for estimating will vary from 50 to 75% of its maximum rating and therefore a reasonably safe estimate would be to use 60% of the maximum rating.

Space does not permit further elaboration of the vital subject of sizing.

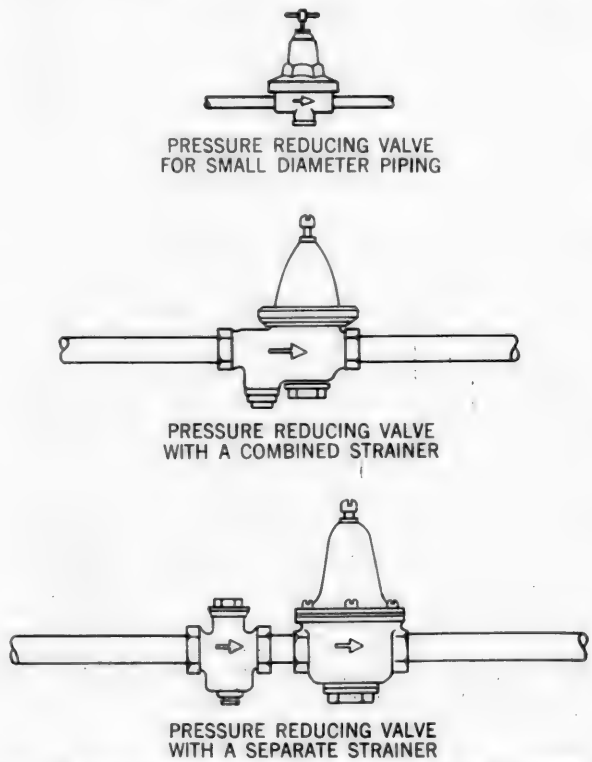
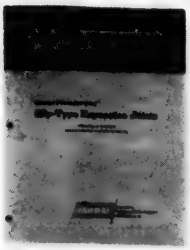


Fig. 7. Section through a self-contained type of pressure reducing valve.

NEW LITERATURE

Use the prepaid postcard on last page for securing your copies of these catalogs.



Slip-Type Expansion Joints

A 6-page folder, entitled Design Procedure for Slip-Type Expansion Joints, is offered by Yarnall-Waring Co., Philadelphia, Pa. A reprint of an article appearing in *Air Conditioning, Heating and Ventilating,* it includes calculations involved in the design of a typical piping system.

Circle **Item 1** on Inquiry Card

Pneumatic Valves

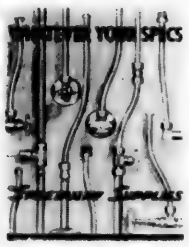
For the engineer who must frequently specify pneumatic valves of various types, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., offers a complete and dependable line. Four-page Bulletin 76-4591 describes the automatic valves, and gives construction details, sizes and styles.

Circle **Item 2** on Inquiry Card

Vertical Water Heaters

Five sizes of vertical, controlled draft water heaters are listed and described in Bulletin 5214, offered by Sellers Engineering Co., Chicago, Ill. Differences in direct and indirect types of vertical heaters are included; also, suggestions for selection of proper model.

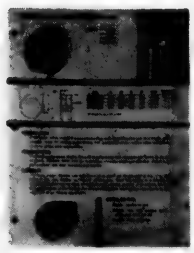
Circle **Item 3** on Inquiry Card



Flexible Plumbing Connections

Brass-Craft Manufacturing Co., Detroit, Mich., announces a 4-page brochure entitled "Whatever Your Specs . . . Speedway Supplies." It points out the advantages of flexible water supply installations to lavatory, closet and sink, and lists a complete line of valve sizes and styles.

Circle **Item 4** on Inquiry Card



Blower Units

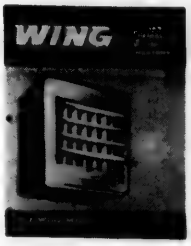
Two technical data sheets on the performance and dimensions of Radiax blower units are published by Air Impeller Div., The Torrington Manufacturing Co., Torrington, Conn. Both describe materials and finishes, and give pressure, speed, power and current curves for different unit sizes.

Circle **Item 5** on Inquiry Card

Propeller Fan Line

A 20-page catalog giving details on the company's complete line of self-cooled motor propeller fans is announced by Ilg Electric Ventilating Co., Chicago, Ill. Catalog No. 159, covering fan capacities ranging from 250 to 40,500 cfm, contains selection data.

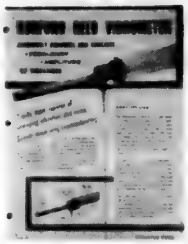
Circle **Item 6** on Inquiry Card



Gas-Fired Unit Heaters

Bulletin GU-100 describes line of gas-fired unit heaters made by L. J. Wing Mfg. Co., Linden, N. J. Bulletin provides construction features, physical data, dimensions, and ratings of the automatic heating units, which are described as flexible in application and exceptionally quiet.

Circle **Item 7** on Inquiry Card



Vibration Measurement

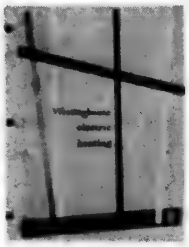
A bulletin describing the company's Reed Vibrometer is available from The Korfund Co., Inc., Long Island City, N. Y. Bulletin K14A describes the device which accurately measures and indicates the frequency and amplitude of vibrations. Frequency range is 120-15,000 cpm.

Circle **Item 8** on Inquiry Card

Steam Specialties

Steam specialties manufactured by Illinois Engineering Div., American Air Filter Co., Inc., Louisville, Ky., are described in a 12-page composite product bulletin, No. 203. It includes valves, float and thermostatic traps, steam traps and pipe line strainers. Dimensions, capacities are included.

Circle **Item 9** on Inquiry Card



Electric Heating Design

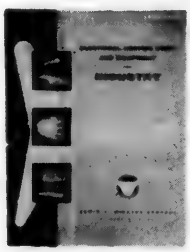
A revised edition of the booklet, Electric Heating Design Guide, is offered by Westinghouse Electric Corp., Pittsburgh, Pa. This 33-page booklet contains a series of colored charts which provide a simple, reliable way to compute electric heating capacity required for most installations.

Circle **Item 10** on Inquiry Card

Packaged Automatic Boilers

Orr & Sembower, Inc., Reading, Pa., offers an 8-page bulletin on its new line of mechanical pressure atomizing oil-fired and partial pre-mixing gas-fired Powermaster packaged automatic boilers. The publication contains data on sizes from 20 through 100 hp.

Circle **Item 11** on Inquiry Card



Electric Process Heaters

Announced by Edwin L. Wiegand Co., Pittsburgh, Pa., is 64-page Catalog 60, illustrating the company's complete line of Chromalox electric process heaters and describing their many uses. Included is a technical section to aid in accurate calculation of heating requirements.

Circle **Item 12** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.

Automatic Controls

A 32-page catalog, No. 1508-AF, describing automatic controls for heating and air conditioning is available from Penn Controls, Inc., Goshen, Ind. Several new listings are shown, including line voltage thermostats for heating and cooling, and a line voltage stack switch.

Circle **Item 13** on Inquiry Card

Light-Wall Fittings, Flanges

Pipe-Mate light-wall stainless steel fittings and flanges for non-critical process piping are described in a 6-page bulletin available from Tube Turns Div., Chemetron Corp., Louisville, Ky. Illustrations show different methods of joining light-wall fittings and pipe.

Circle **Item 14** on Inquiry Card

Fractional Horsepower Motors

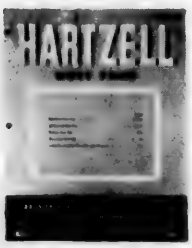
A 12-page catalog, offered by Redmond Co., Inc., Owosso, Mich., describes and illustrates the company's basic line of fractional horsepower electric motors, blowers, and special products. Dimensional diagrams, standard ratings, recommended applications are included in catalog.

Circle **Item 15** on Inquiry Card

Fittings for Plastic Pipe

New catalog sheets are offered by Industrial Plastic Fittings Div., The R & K Plastic Industries Co., Towson, Md. Catalog No. SWP-1 lists plastic SWP-size fittings for ABS Type II material. Catalog No. IF4, illustrated, describes plastic insert fittings for polyethylene pipe.

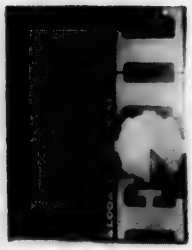
Circle **Item 16** on Inquiry Card



Belt-Drive Duct Fans

A new line of belt-drive duct fans, with adjustable driver sheaves which permit easy adjustment of fan speed, is described in Bulletin A-114A, issued by Hartzell Propeller Fan Co., Piqua, Ohio. Twelve-page bulletin also covers direct-drive, reversible and bypass types.

Circle **Item 17** on Inquiry Card



Industrial Uses of Aluminum

A summary of the industrial uses of aluminum foil is provided in a 26-page booklet published by Aluminum Company of America, Pittsburgh, Pa. It illustrates varied uses for the metal in architectural, electrical, heating, cooling, packaging, and other key applications.

Circle **Item 18** on Inquiry Card

Small Pipe Welding

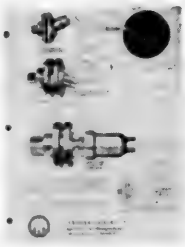
Two technical articles on small pipe welding, written by A. N. Kugler, chief welding engineer, Air Reduction Sales Co., Div. of Air Reduction Co., New York, N. Y., are available in booklet form. The articles appeared originally in *Air Conditioning, Heating and Ventilating.*

Circle **Item 19** on Inquiry Card

Condensate Drainage Control

A brochure, describing the C-B system of condensate drainage control and explaining how the "jet action" principal is employed, is offered by Cochrane Corp., Philadelphia, Pa. Publication 6001-B lists many industries now using the system for increased production, lower steam cost.

Circle **Item 20** on Inquiry Card



Adjustable Nozzle Joints

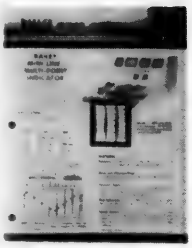
Reference data on the company's adjustable joints for spray nozzles are included in Bulletin 97, published by Spraying Systems Co., Bellwood, Ill. These adjustable joints are seen by the company as being an essential part of many types of spray nozzle installations.

Circle **Item 21** on Inquiry Card

Central Station Air Conditioners

A 76-page catalog, No. 9227, describing the American Blower line of low and high pressure central station air conditioners is available from American-Standard Industrial Division, Detroit, Mich. For each type of unit in the line, a recommended selection procedure is outlined.

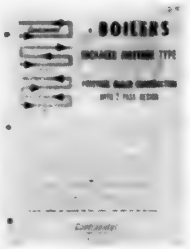
Circle **Item 22** on Inquiry Card



Vertical Gage Units

A compact group of individual miniature vertical gage units, known as Mini-Line multi-point indicators, is described in 4-page Product Specification P11-1, published by Bailey Meter Co., Cleveland, Ohio. Standard operating ranges, external and mounting dimensions are included.

Circle **Item 23** on Inquiry Card

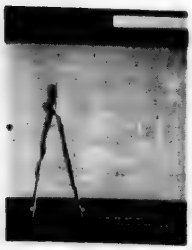


Packaged Firetube Boilers

Why 2-pass firetube packaged boilers offer the most efficient boiler design for fuel economy and lower operating costs in all types of industrial plants and institutions is the subject of 4-page Bulletin BE-100, issued by Boiler Engineering & Supply Co., Inc., Phoenixville, Pa.

Circle **Item 24** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of these catalogs.



Condensation Pumps

An informative 12-page catalog, J-200, describing four different types of vacuum return line condensation pumps for heating systems is offered by Pump Div., C. H. Wheeler Manufacturing Co., Philadelphia, Pa. Catalog contains specifications, dimensions, and operating characteristics.

Circle **Item 25** on Inquiry Card

Gas Water Heater Control

The 200R Unitrol gas water heater control is described and illustrated in a publication, GW-23, issued by Grayson Controls Div., Robertshaw-Fulton Controls Co., Long Beach, Calif. Control has a slip-off cover which conceals gas cock and reset push button, thereby reducing dust accumulation.

Circle **Item 26** on Inquiry Card

150-Lb Welding Fittings

Nibco Inc., Elkhart, Ind., announces its Husky Catalog H-1, describing steel welding fittings for non-critical plumbing, heating and cooling systems. Catalog, a complete purchasing guide, lists all sizes and styles for 45 and 90 degree elbows, straight and reducing tees, and concentric reducers.

Circle **Item 27** on Inquiry Card

Low-Capacity Chemical Feeder

B-I-F Industries, Inc., Providence, R. I., announces a bulletin, Ref. No. 1913.20A-1, describing the Proportioneer Model 19131 chemical feeder for low cost controlled feeding of hypochlorite or other water treatment chemicals into small water systems. Operational data are included.

Circle **Item 28** on Inquiry Card

Industrial Pumps

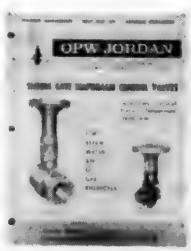
Centrifugal and rotary pumps for a wide range of industrial uses are described in a 72-page catalog issued by Paris Products Div., Detroit Harvester Co., Oak Park, Mich. Catalog covers pumps designed for special conditions of temperature, viscosity, specific gravity, and lubrication.

Circle **Item 29** on Inquiry Card

Smoke Alarm-Control Units

Photomation, Inc., Bergenfield, N. J., offers Bulletin 553 which describes the operation of electric-eye units to guard against combustion smoke being circulated through air conditioning systems. Units will give split-second alarm, and shut down fan or close dampers to stop air flow.

Circle **Item 30** on Inquiry Card



Diaphragm Control Valves

An 8-page bulletin, No. J-170, describes the sliding gate and plate diaphragm control valves available from OPW-Jordan, Cincinnati, Ohio. Complete engineering data, cutaway drawings, application information, dimensional drawings, flow capacities, rating charts, and sample specs are included.

Circle **Item 31** on Inquiry Card

General Purpose Relays

A complete line of basic general purpose relays is described in a 16-page catalog published by Guardian Electric Mfg. Co., Chicago, Ill. Each relay is associated with detailed dimensional drawings, available contact arrangements, current and coil operating data, and mounting information.

Circle **Item 32** on Inquiry Card

Automatic Coal Heating Equipment

Worley Equipment, Inc., Chicago, Ill., manufacturer of coal stokers for residential and smaller industrial installations, announces a 16-page catalog listing 19 stoker models, with capacities from 15 to 630 lb per hr. Specifications and dimensions are given for each model.

Circle **Item 33** on Inquiry Card

Steel Cooling Towers

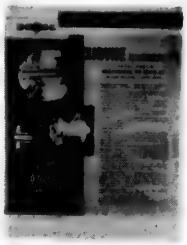
A 6-page bulletin, No. 53-902, is offered by J. F. Pritchard & Co. of California, Kansas City, Mo. Bulletin describes, and gives engineering data for, the company's Series CF horizontal induced draft steel cooling towers. The units, in sizes from 2 to 120 tons, feature self-cleaning basin.

Circle **Item 34** on Inquiry Card

Line of Welding Fittings

A welding fitting catalog, Form No. 593, is available from Dresser Manufacturing Div., Bradford, Pa., one of the Dresser Industries, covering its expanded line of seamless carbon steel welding fittings. The 40-page catalog contains specifications, engineering drawings, and ASA tables.

Circle **Item 35** on Inquiry Card



Power Transmission Machinery

A review of the company's line of power transmission machinery is presented in 8-page Bulletin A-706 by Dodge Manufacturing Corp., Mishawaka, Ind. Featuring Flexidyne dry fluid drives and Para-flex flexible cushion coupling, bulletin also describes Dyna-V-Pac of V-belt drives.

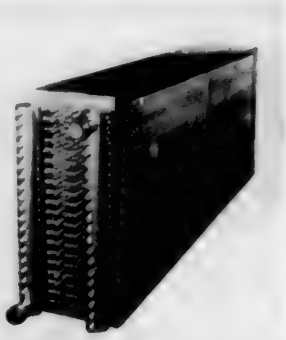
Circle **Item 36** on Inquiry Card

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on the last page for securing additional information about new equipment and materials described in this department.

Cleanable Cooling Coils

A major sale of cleanable water coils to the General Services Administration of the United States Government helps to introduce a new line of chilled water cooling coils by Halstead & Mitchell, Pittsburgh, Pa.



Advantages of cleanable chilled water cooling coils under bad water conditions are obvious. A build-up of sediment is avoided, making coils particularly suitable for central station or zone air conditioning systems in many parts of the country.

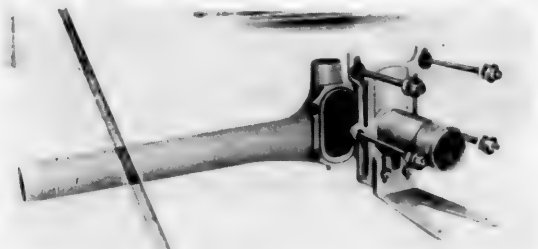
Like all finned coils manufactured by the company, these feature the Turbu-Flo fin to provide an extra measure of heat transfer capacity. The embossed, streamlined pattern increases fin surface and results in better air wash. This steps up heat transfer by as much as 15%, the company reports.

Coils are available with finned surface heights ranging from 12 to 36 inches, and in 3-inch multiples. Lengths range from 24 to 120 inches, in 6-inch multiples. Coils can be built with one to eight rows, and with fins running 6, 7, 8, or 10 to the inch.

More information? Circle Item 37, postcard, last page.

Combined Fittings, Chair Carriers

A line of long barrel adjustable combined fittings and chair carriers is announced by Jay R. Smith Mfg. Co., Union, N. J. According to the company, the units are designed to save time, labor, cost, and material when installing wall-hung fixtures on horizontal battery runs.



Providing an extra-long spigot on the fitting, the long barrel fittings are caulked into each other to form a continuous horizontal drainage line without requiring any additional piping and eliminating the caulking of extra joints.

The spigot end of each fitting is provided with cut-off rings which facilitate the cutting of the fitting to the desired length so that closets may be set on centers from 30 to 36 inches.

Fittings are available for syphon jet or blow-out fixtures, in double or single, left- or right-hand fittings.

More information? Circle Item 38, postcard, last page.

Specialty Wrought Iron

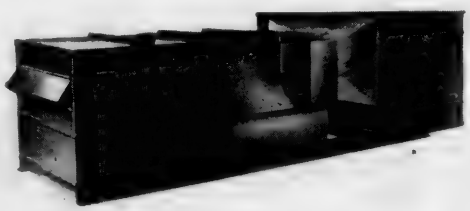
Continuing the pattern of progress that led to the development of 4-D wrought iron in 1958, A. M. Byers Co., Pittsburgh, Pa., announces the development of a specialty wrought iron which possesses better impact and low temperature properties than most steels.

The new alloy is designated "Mn" wrought iron after its principal alloying element, manganese. It is available in tubular and flat rolled forms at the same price as 4-D wrought iron. It is intended for use in the petroleum, chemical and refrigeration industries, as well as other services where the possibility of brittle failure poses engineering problems.

More information? Circle Item 39, postcard, last page.

Roof-Top Heating-Cooling Unit

Packaged year-round air conditioners which can be installed with a minimum of engineering and labor on the roof of one-story buildings have been introduced by Carrier Corp., Syracuse, N.Y. Units heat with gas, cool with electricity, and are built in two sizes: 200,000 Btu per hr input heating coupled with 7½-hp cooling, and 250,000 Btu per hr heating linked with 10-hp cooling.



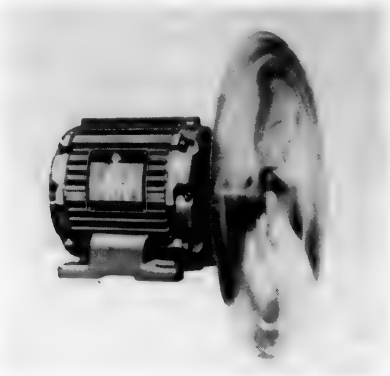
Factory assembled and wired in one weatherproof cabinet, each unit is set over an opening in the ceiling and is fitted to a diffuser. The unit draws return air up through the center of the diffuser and discharges conditioned air down and out the sides. No ductwork is required. A damper controls the mixture of outside air. Single gas, electric, and thermostat connections are used.

The company believes the units will find a large market in industrial buildings and shopping centers. Installation flexibility is obtained by locating units near the greatest heating-cooling load. For instance, two might be installed at the front of a supermarket near glass areas and doorways, while another might heat and cool the entire rear.

More information? Circle Item 40, postcard, last page.

Fan Cools its Motor

A line of Air-Over fan motors in ratings from 1 to 125 hp is announced by The Louis Allis Co., Milwaukee, Wis. Motors are designed for quiet operation in ventilating systems, exhaust systems, cooling towers and all air moving installations where a motor drives a propeller or



axial flow fan. Motor design makes use of air circulated in these installations to cool the motor so that maximum horsepower can be produced from a minimum motor size.

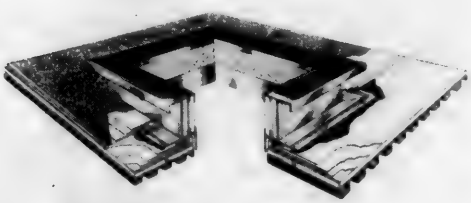
In the overall design of air moving installations, this permits use of a smaller, lighter motor for any desired capacity, the company points out. Individual motor nameplates indicate three horsepower ratings (nominal, operating and maximum horsepower) that can be achieved by varying the air velocity across the motor.

Motors are available with foot or flange mountings, in totally enclosed and explosion-proof enclosures, and are suitable for vertical or horizontal mounting.

More information? Circle Item 41, postcard, last page.

Roof Ventilator Curbs

Extruded aluminum acoustically and thermally insulated roof ventilator curbs are offered by Penn Ventilator Co., Inc., Philadelphia, Pa. Expensive job hold-ups, waiting for a field curb to be installed, are eliminated when these self-flashing extruded aluminum Sonotrol curbs are used, the company states. The curb can be ordered as soon as the necessary roof opening dimensions are determined, and it will be delivered when needed.

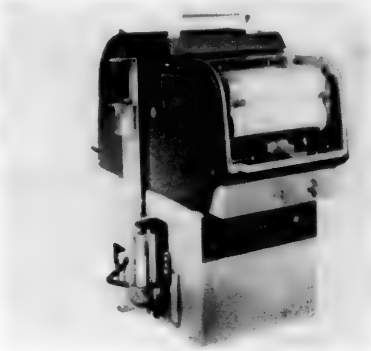


The self-flashing feature of the curb saves time and money because curb measurement in the field does not have to wait for the roofer to finish flashing. Ventilator, damper, and curb are supplied by the company and everything fits. Acoustical and thermal insulation in the curb is said to help absorb a significant percentage of fan noise. It reduces sound energy and reflections.

More information? Circle Item 42, postcard, last page.

Portable Carbon Dioxide Recorder

Development of a portable carbon dioxide recorder for flue gas analysis and furnace adjustment is announced by Thermco Instrument Corp., La Porte, Ind. This makes it possible to have the advantage of continuous reading

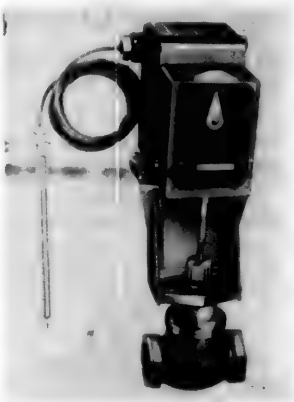


and a record to show all the variations in operation, even when unattended, the company says. Range is 0-20% CO_2 in flue gas; size, 17 by 14 by 10 inches; weight, 50 lb; power required, 115 volts, 60 cycles.

More information? Circle Item 43, postcard, last page.

Self-Contained Regulator

A temperature regulator for proportional control of water, gas, or low-pressure steam is designed by Barber-Colman Co., Rockford, Ill., for all applications where a self-contained valve assembly may be particularly suited. Described as a tight-closing, ruggedly constructed, self-contained unit, it offers the installation advantages of a self-contained controller, with the additional features of a clearly marked calibrated adjusting dial for precise temperature control, a rugged electric industrial motor operator, and armored capillary tubing.



Typical applications include package air conditioning units, hot water storage tanks, plating tank control, industrial process control, and bottle washers.

No assembly, linkage, or adjustment is necessary either before or after installation, except for the setting of the control dial to the desired temperature. A simple two-wire connection is made to almost any available power supply.

More information? Circle Item 44, postcard, last page.

Air Filters Trap, Kill Germs

A complete line of air filters which trap and kill germs is introduced for medical, home, industrial and institutional use by Fram Corporation, Providence, R.I. The new filters will fit all types of air conditioners, furnaces and air circulators.

Independent laboratory tests by Hazelton Laboratories, Falls Church, Va., indicate that the filters remove 90 to 98% of all germs reaching the filter, and kill more than 99% of these. The germicidal efficiency is permanent.

The germicidal agent used in the filters is called Permachem, and is being adapted for use in many other products. Fram has exclusive licenses for its use in air filtration.

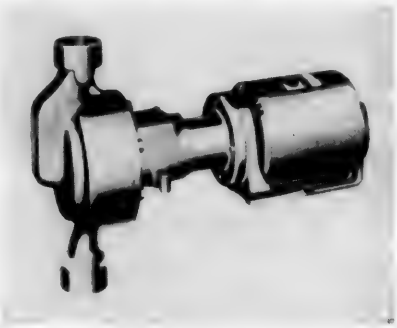
Filtering media consists of dry synthetic fibers which are bonded together to form a "depth-maze" of dirt traps. The Permachem treated cellulose acetate material is odorless, white, nonsplintering and nonirritating. Mounted in specially stitched frames, the filters have longer life than currently used materials and are unaffected by humid operating conditions, the company reports.

More information? Circle Item 45, postcard, last page.

High Head Circulators

Taco Heaters, Incorporated, Cranston, R.I., announces the addition of a series of high head circulators to its present line. This new series will be available in six sizes and with single or three phase non-overloading motors. Units feature:

Inline installation, cast iron or bronze construction, closed impellers cast in one piece—dynamically balanced,



stainless steel shafts, slinger-ring-lubricated sleeve bearing, heads to 45 ft and flows to 55 gpm, an angle base—optional at extra cost for basemounting, bronze-fitted models available at no extra cost, quiet operation, rubber coupling, ceramic and carbon mechanical seal, and rubber-mounted motors.

Circulators are designed specifically for heating, cooling, boosting water pressure and recirculating hot water applications.

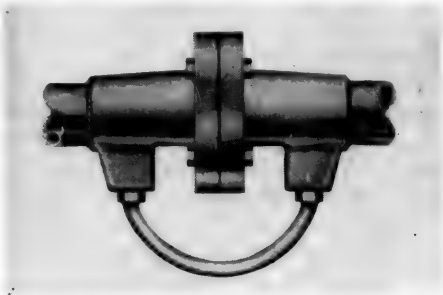
More information? Circle Item 46, postcard, last page.

Fittings for Steam-Traced Piping

Aluminum Company of America, Pittsburgh, Pa., moving to supply a widening range of Unitrace applications, announces three new components and increased maximum size for the piping with integral steam tracing.

This piping is now available with an outside diameter equal to 8-inch pipe. The family of fittings developed to incorporate Unitrace into standard piping systems includes a cast flange, adapter flange, and 90-degree elbows.

The flange, illustrated, is cast in alloy 356-T7 and



makes possible simple and efficient joining of Unitrace sections. Trace line first is cut back. The product line then is inserted into the flange, and welded at the neck and front face. Steam is led around a flanged joint by a jumper line threaded into a connection in each flange bottom. When steam is introduced, a special impingement plate prevents erosion of the product pipe.

More information? Circle Item 47, postcard, last page.

Chemical Proportioning Pump

An electrically driven, positive displacement chemical proportioning pump is introduced by B-I-F Industries, Inc., Providence, R. I. Proportioneers Model 1210 Chem-O-Feeder features a corrosion-resistant transparent plastic head, Hypalon diaphragm and check valves, and a straight-through flow design.

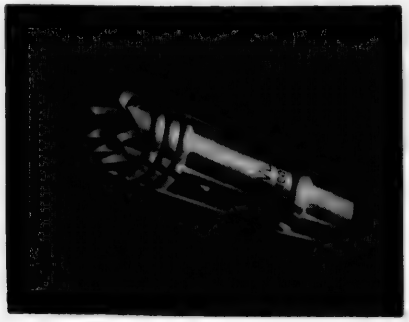
The unit is said to proportion chemical solutions, acids, and alkalies, accurately and uniformly, to process water in industry. It is recommended for the water treatment field, for industry, swimming pools, chemical plants, and municipalities—wherever precise and controlled feeding of chemicals is needed.

Pump is available in three models, simplex, duplex and triplex, for adjustable, wide-range proportioning up to 12, 24 and 36 gph with discharge pressures up to 125 psi. Complete package, ready for installation, includes pump, suction and discharge tubing, injection nozzle, foot valve, tools, and spare parts, and instructions.

More information? Circle Item 48, postcard, last page.

Masonry Drill and Anchor

Fastening fixtures to concrete is said to be speeded and simplified by a combination masonry drill-anchor introduced by The Rawlplug Co., Inc., New Rochelle,



N. Y. Called Saber-Tooth, the anchor drills its own hole, then is driven into it to form an anchorage with holding power up to 17,860 lb.

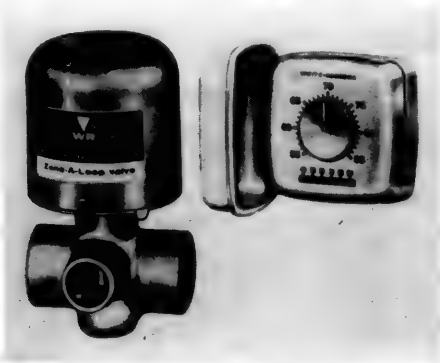
Holes are drilled quickly, even in hard concrete, by the drill-anchor's core action. Since drill and anchor are one, matching sizes is no problem. The drill-anchor saves the cost of special drills and the time it takes to use, store and sharpen them.

More information? Circle Item 49, postcard, last page.

Hot Water Zone Control

Zone-A-Loop is described as an economical zone control package for single-pipe hot water heating systems. Introduced by White-Rodgers Co., St. Louis, Mo., it is designed for use with either new or existing systems, providing the advantages of zoning, but reducing installation costs with simplified components and low-voltage wiring.

Each zone is equipped with a low-voltage thermostat and a small automatic water valve. Of rotary design, the valve allows unrestricted flow through the feeder pipe when the thermostat is not calling for heat.



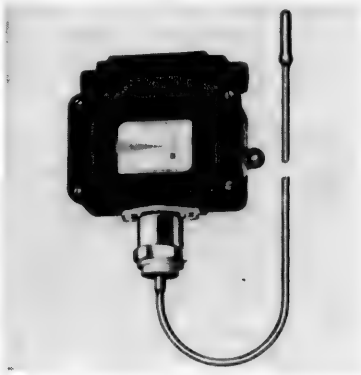
In use, the valve is mounted at either inlet or outlet of the radiator. On call for heat, the valve's half-round stem rotates 120° from closed. Flow in the feeder pipe is divided; part diverting to the radiator, the rest bypassing to the next zone. With the zone satisfied, the valve stem again rotates, closing off flow to the radiator and allowing unobstructed flow in the feeder line.

Said to be completely silent in operation, the valve motor uses current only when opening or closing. The valve's slow-opening feature eliminates water hammer and system expansion noises, by gradually blending water temperatures.

More information? Circle Item 50, postcard, last page.

Shuts Off Gas in 45 Seconds

The Partlow Corp., New Hartford, N. Y., announces SBS safety switch which will shut off all fuel in 30 to 45 seconds if the pilot in any gas-fired industrial heating operation becomes extinguished.



Under normal operating conditions, a mercury-filled bulb, installed close to the pilot flame, is heated a bright red. Switch remains in a depressed position, and an indicating dial registers normal operation. If the pilot is extinguished, mercury vapor condenses, interrupts the circuit to the solenoid valve or other device, while an indicating needle drops, showing pilot flame is out.

The company recommends use of the safety switch with its Model 270-A pilot burner, which has a built-in holder for the bulb which positions it properly in relation to pilot flame.

More information? Circle Item 51, postcard, last page.

Air-Cooled Condenser Line Improved

Its air-cooled condenser line has been materially improved and broadened, it was announced by Drayer-Hanson, Div. of National-U.S. Radiator Corp., Los Angeles, Calif.

Maximum capacity obtainable per single unit is now 87 nominal tons. (Largest previous single-unit capacity was 25 tons.) Unlimited tonnages may be had via duplexing, the manufacturer states.

Condensers operate on the draw-through principle, said to assure full, uniform use of coil and an easy cleaning of finned surfaces. The self-contained, remote-type unit is available for ceiling or wall suspension, indoor or outdoor.

Design features include the extremely low profile of the unit; flexibility in installation; and the upblast of discharge air, which carries most of the sound up. Prevailing winds do not dictate positioning. All motors are totally enclosed, fan cooled. Over-size access door provides for ready inspection and maintenance.

More information? Circle Item 52, postcard, last page.

Packaged Fume Washers

Cyclonaire fume washers, produced by Process Equipment Div., U. S. Stoneware, Akron, Ohio, for the process industries, are said to provide a series of low-cost, compactly-built units, with washing efficiencies found in custom-built installations.

Simple design and construction, the manufacturer states, make it possible to install a standard washer in a few hours. In an equally short time, the unit can be dismantled and reassembled in another location.

Components include a bottom section, containing a packing support plate, fume intake duct, and a liquid drain; two intermediate sections packed with Intalox saddle packing; a distributor section containing water or liquid inlet and liquid distributor; and a top section which includes the rotor, drive motor, and air exhaust outlet.

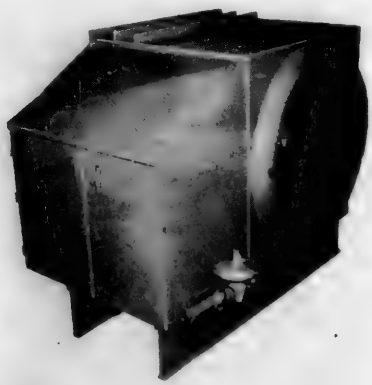
In operation, fume-laden air is drawn into the washer, drawn through the intermediate sections filled with saddle packing. Water is sprayed over the packing by an injection type distributor. Air, rising in the tower, is scrubbed by the descending water. Saddle packing may be omitted for use of the tower as a dust eliminator. A mist eliminator is added if exhaust air is to be reintroduced into the room. Modifications are available for eliminating non-water-soluble fumes.

More information? Circle Item 53, postcard, last page.

Gas-Fired Intake Units

A line of direct-fired intake units, for supplying tempered outside air to replace air removed by industrial exhaust systems, is available from Hartzell Propeller Fan Co., Piqua, Ohio.

Almost 100% efficient heat transfer is accomplished because natural or propane gas is consumed in a line-of-flame burner mounted directly in the entering air stream. The products of combustion are thus mixed with the large volumes of incoming fresh air. Illustration shows view of unit from discharge side.



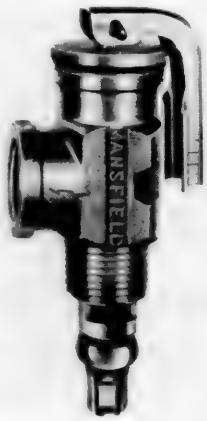
Basic models are rated at 2, 4 and 6 million Btu per hr, with air volumes of 25,000, 50,000, and 75,000 cfm. They may be installed on the roof or in a wall opening, and used with or without a duct system for air distribution.

Standard models have a propeller fan mounted in the air stream; but vaneaxial, tubeaxial or centrifugal fans for external mounting can also be supplied. Accessories include an intake rain shield, filter housing with permanent filters, and motor-operated shutters. Standard control system is said to provide completely automatic operation with absolute safety for precise control of temperature rise from 10 to 85 deg F.

More information? Circle Item 54, postcard, last page.

T-P Valves Are Adjustable

Two automatic temperature-pressure relief valves are announced by Mansfield Sanitary, Inc., Perrysville, Ohio. Designated Models 496 and 497, they protect against both excessive pressures and temperatures when inserted in either hot water lines or tanks. An AGA-approved thermo-setting element of each provides effective temperature relief action and assures immediate closing of the valve after a 10-deg F drop in water temperature, the company states.



Units can be adjusted to relieve water at any pressure between 50 and 200 psi. Stainless steel control spring is said to assure instant relief whenever setting is exceeded.

No. 497 is identical to No. 496, except it is equipped with a combination test lever and adjusting key that fits exactly into the slot on the top of the pressure cap. By looking across the valve top and following figures marked on the lever, pressure can be quickly and accurately set.

Constructed with red brass bodies, valves have Btu ratings of 150,000. Male and female outlets are both ½ inch.

More information? Circle Item 55, postcard, last page.

Plastic Air Washer

A polyvinyl chloride air washer, designed to eliminate corrosive elements in air streams, is available from Argo Plastic Products Co., Cleveland, Ohio. It is recommended for chemical plants, electroplating establishments, laboratories, etc. Its PVC construction makes it resistant to corrosion.

Twenty sizes, handling from 1000 to 55,000 cfm, are offered. Each unit is made up of three sections. In the first, air enters and loses its velocity, coming into contact with PVC spray nozzles. In the second section, contaminated air enters, being thoroughly soaked as its course is altered several times. The third section eliminates entrained water, resulting, the company states, in 90-98% clean air.

More information? Circle Item 56, postcard, last page.

Electric Chlorinating Unit

An electrically operated, positive feed chlorinating unit, designed for use in farm, home, and commercial water well systems, as well as swimming pools, is announced by Clayton Mark & Company, Evanston, Ill.

Engineered to treat up to 75,000 gallons of water daily, enough for trailer parks, resorts, summer camps, and commercial establishments, the Electraclor duplicates at minimum cost the expensive water purification services of metropolitan communities.

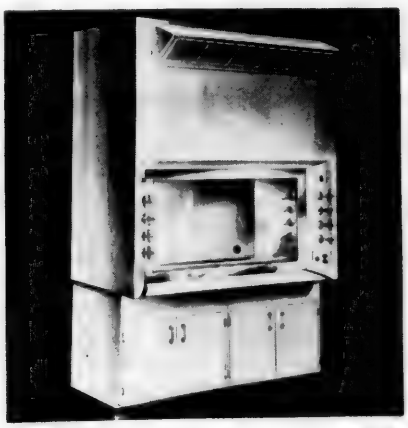
In operation, the unit injects a tiny stream of ordinary liquid household chlorine bleach into the water supply in the exact proportion needed to safeguard health. The unit's rate of feed can be adjusted by a finger tip control knob, used to set the strength of the chlorine solution in the tap water within the ratio range prescribed by state health departments.

The company provides a simple chemical test kit with each unit which enables the owner to make an easy, five-second eye-check of his tap water to make sure the chlorine solution has the recommended strength. Once the chlorinator is set, it will maintain the same proportionate feed on any amount of water drawn from the well.

More information? Circle Item 57, postcard, last page.

Hoods for Conditioned Labs

A line of auxiliary-air type Airflow fume hoods for air-conditioned laboratories is announced by Kewaunee Mfg. Co., Adrian, Mich. They operate with the same high efficiency as do the company's standard units, but use a ratio of 50% room air from the building air-conditioning system and 50% auxiliary air.



When operating at a minimum face velocity of 50 fpm, these hoods exhaust only 25 cfm of air per square foot of sash opening obtained from an auxiliary air source.

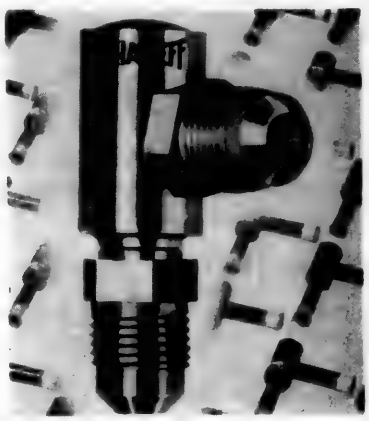
An additional advantage, the company states, is that all air (both room and auxiliary) enters through the hood face, which arrangement is virtually 100% effective in sweeping fumes back to the baffle exhaust openings.

More information? Circle Item 58, postcard, last page.

Multi-Duty Check Valve

Chatleff Valve and Mfg. Co., Austin, Tex., announces the availability of a multi-duty check valve engineered for the heat pump.

Valve is constructed of dense, uniform brass throughout, with Teflon seating. Unit is hermetically sealed. Inconel-x springs are said to be unaffected by moisture and heat.



According to the manufacturer, valve is instant-acting, silent, and non-chattering. A high pressure check, it will seal at low pressure. The check element moves clear of the stream in open position.

Heat-pump applications are facilitated by the heat-resistant Teflon seating, which will not be damaged when valve is silver brazed into the system. In addition, the seat material is said to be extremely tough and to be completely free from reactions with the Freons and oils.

More information? Circle Item 59, postcard, last page.

Glass Fiber Roof Ventilators

A full line of belt-drive roof ventilators made of Fiberglas has been introduced by The Swartwout Co., Cleveland, Ohio. According to the manufacturer, they can hardly be heard when operating.

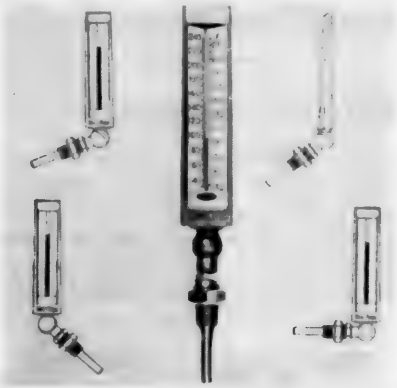
Called Fiber-Aire, these units are said to have exceptional efficiency and provide capacities from 180 to 13,500 cfm. Bonded Fiberglas housings are virtually indestructible. They withstand severe impact, weather, temperature and most chemicals. Housings absorb noise and vibration and do not act as a sounding chamber. Molded-in, sky-blue color and low contour fit architects' needs for ventilators that do not break up clean architectural lines.

Stainless steel air flow guides eliminate internal air shocks and add to operational efficiency.

More information? Circle Item 60, postcard, last page.

Thermometer Turns and Tilts

Princo MultiForm, an industrial thermometer which can be turned or tilted to the most favorable reading



position after the stem is in place, is offered by Precision Thermometer & Instrument Co., Philadelphia, Pa. The instrument's locking device allows for quick reset to any desired form should it be moved to a new location.

More information? Circle Item 61, postcard, last page.

Hubbed Polyethylene Pipe

A hubbed sewer pipe and a hubbed perforated drain pipe, both made of high-density polyethylene, a product of Koppers Company, Inc., is manufactured by Pyramid Industries, Inc., Erie, Pa. Marketed as Pi-Mar S (sewer) and D (drain), pipe is unique in that the hubbing is an integral part of the pipe, which eliminates the need for a separate coupling. It is easy to install and can be cut with a handsaw. No special tapering tools are required, and no adhesives, the company states.

Impervious to waste acids and alkalis, this pipe will not rot, rust or corrode. and is said not to fracture when subjected to the sort of abuse that breaks other conventional types of pipe.

Pipe is available, also, in double-hubbed lengths. According to the manufacturer, it is competitively priced with fiber pipe and other types of plastic pipe, and is approximately one-third the cost of cast-iron pipe. Water absorption is practically non-existent; its crushing strength is well over 800 lb, with no fracture; and it meets new, proposed Standard Specifications for plastic sewer and drain pipe as submitted to the Department of Commerce.

The hubbed sewer pipe is made in 2, 3 and 4-inch diameters and 10-ft lengths, which are standard industry sizes. The hubbed, slotted drain pipe is made in diameters of 2, 3 and 4-inches. Both sewer and drain pipe can be made in 20-ft lengths, or special lengths, to order.

Suggested applications include sewer-to-house connections, house-to-septic tank, downspouts, industrial sewage lines for raw sewage and special wastes, septic tank disposal fields, storm drains, foundation footing drains, land and roadbed drainage.

More information? Circle Item 62, postcard, last page.

Laboratory Service Fixture

One of the versatile service fixtures for school and industrial laboratories in the new Lab-Flo line, manufactured by T & S Brass and Bronze Works, Inc., Westbury, Long Island, N.Y., is Model BL-4200 laboratory turret, fitted with the company's standardized and interchangeable (BL-4000) heavy duty hose cock. It is de-

signed for gas, air or vacuum with a plastic color-coded index to identify the respective service. The turret unit has extra heavy chrome plating, a ⅜-inch IPS female inlet, and is available with one, two (in 90 or 180 degrees), three or four hose cocks to accommodate required services. Integral tapered tips with 10 serrations provide secure hose attachment. Turret is also available without hose cocks and with ⅜-inch IPS female outlets.

More information? Circle Item 63, postcard, last page.

Larger Oil-Fired Water Heaters

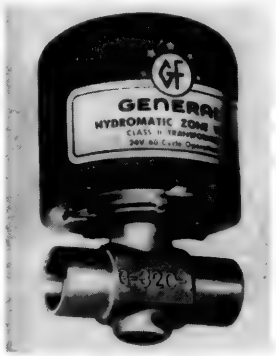
Units of 65 and 70-gal storage capacity, copper and glass lined respectively, are added to its line of oil-fired hot water heaters by The Carlin Co., Wethersfield, Conn. Copper-lined models of 30 and 45-gal capacity and glass lined models of 30 and 50-gal capacity were offered previously.

The new units meet the needs of restaurants, multiple dwellings, small motels, schools, churches, and other institutions using quantities of hot water. Copper lined water heaters are particularly in demand for food service establishments where quantities of hot water, both 130-deg F general purpose water and 180-deg sanitizing water, are required over extended periods.

More information? Circle Item 64, postcard, last page.

Hydronic Zone Valves

Thermostatically-controlled, rotary type valves which can be easily installed in supply lines in any position are designed for economical multiple-zone hydronic heating systems by General Fittings Co., East Greenwich, R.I.



Zone valve-thermostat combinations are suitable for either new or existing hot water systems. Available in three sizes (¾, 1, and 1¼ inches), valves meet FHA requirements for zone-heating split level homes. They permit the use of smaller pipe sizes, less pipe, and low voltage wiring, with only one circulator and one relay required, the company states.

More information? Circle Item 65, postcard, last page.

Ceiling-Mounted Hose Reel

Safe, out-of-the-way storage of hoses for piped operating room and recovery room vacuum and gas services is provided in a ceiling-mounted hose reel introduced by National Cylinder Gas Div., Chemetron Corp., Chicago, Ill. The company states that the reels will be supplied in two-gang and four-gang styles suitable for from one to four hoses in any combination of piped services, including oxygen, vacuum, air, carbon dioxide and nitrous oxide.

Each hose can be used in any part of the room up to 15 ft from the ceiling outlet. Hoses are color coded and equipped with non-interchangeable quick couplers to prevent their being used with any service other than the one intended. When not in use, all hoses can automatically be reeled out of the way into the ceiling, eliminating the inconvenience and danger from hanging hoses or from connections to wall outlets, the company states.

Both two-gang and four-gang reel assemblies are housed in sturdy steel cases and are designed for easy, in-the-ceiling installation by means of bolts to ceiling channels. Two-gang units, for one or two hose reels, can be mounted in a single 12-by-12-inch ceiling tile space. Four-gang types permit mounting of three or four reels in two standard tile spaces.

The stainless steel cover is easily removed for access to reels, outlets and hoses. The hoses are made of a tough, lightweight conductive rubber material featuring a smaller outside diameter without reduction of inside dimension.

More information? Circle Item 66, postcard, last page.

Wall-Mounted Cooler

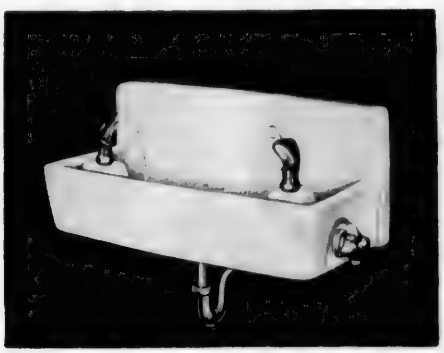
A wall-mounted electric water cooler of slim design, which leaves floor areas unobstructed, is available from Haws Drinking Faucet Co., Berkeley, Calif. Designated Model HWT-13, this extremely compact cooler delivers approximately 13 gph of precooled water, ample supply, the company states, for over 220 persons in commercial and institutional locations. As illustrated, plumbing and electrical systems are entirely concealed in hammertone enameled steel cabinet.

Cooler is 24 inches high, 15¾ inches wide, and 13 inches deep. Water is dispensed through the company's shielded, push-button type, chrome plated brass bubbler. The smoothly contoured stainless steel top is designed to prevent splashing and facilitates cleaning. An optional glass filler accessory mounts directly behind bubbler. This chrome plated unit, No. 981-5, meets all plumbing codes.

More information? Circle Item 67, postcard, last page.

Battery Fountain Announced

Development of a battery fountain of heavy vitreous china is announced by Universal-Rundle Corp., New Castle, Pa. Called the Cameo, the fountain is face mounted, with integral back.

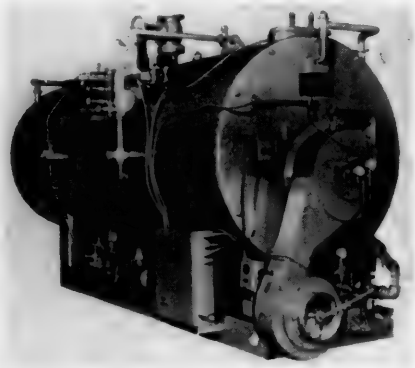


Features include concealed hangers, brass strainer, 2 loose key compression stops and cast brass *P* trap. There are two 2-stream mound building projectors and automatic stream control. All exposed fittings are chromium plated.

More information? Circle Item 68, postcard, last page.

Air Atomizing Packaged Boilers

Introduced by Ames Iron Works, Inc., Oswego, N.Y., Model AA offers an advanced design, low pressure, air atomizing oil burner and an all-new ring type gas burner. Burners provide stable, uniform flame patterns, and cleanly burn all grades of oil or gas at extremely low noise levels, over a modulating range of 5 to 1, the company states.



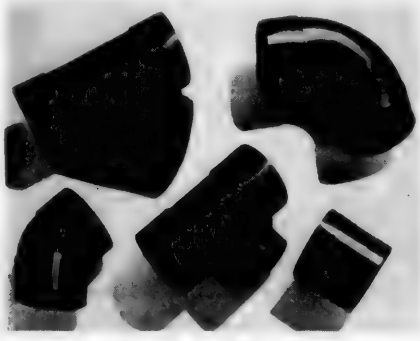
Units for heavier oils include combination steam and electric fuel preheaters: No. 4 oil may be burned with little or no preheating. An air purge of oil lines is provided after each firing cycle. Since Model AA requires smaller motors and fuel preheaters, power costs are reduced, it is said.

Boiler is a complete package, including boiler, burner, controls, refractory and insulation, with the entire assembly fire-tested before shipment.

More information? Circle Item 69, postcard, last page.

Plastic Sanitary Fittings

Molded plastic sanitary fittings are announced by Carlon Products Corp., Aurora, Ohio. The fittings are designed for use with the company's 4-inch "D" sewer and drain pipe. They are made from the same, high-impact, plastic formula developed several years ago for sewer and drain pipe use.

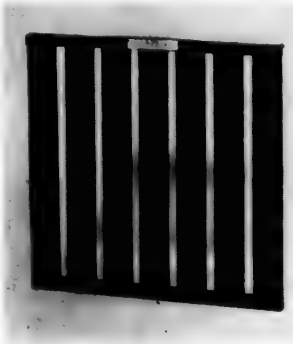


Fittings are available in Y's, T's, 45° and 90° elbows, and couplings. Each shape is a single piece, and is easily solvent welded to the plastic pipe with a brush and solvent cement to provide root-proof, leak-proof joints. Fittings are said to provide better flow efficiency because inside diameters remain constant, even on turns, the company states. Like the pipe, the fittings cannot absorb water, will not mush up, and are immune to rust and eletrolytic corrosion. The compound from which they are made withstands all common household chemicals and detergents, sewer gas, and corrosive action of all types of soil.

More information? Circle Item 70, postcard, last page.

Charcoal Odor Adsorber

A new odor adsorber is offered by Barnebey-Cheney Co., Columbus, Ohio. It installs with conventional dust filters in commercial and residential heating and cooling systems. Called Partial Air By-Pass (PAB), it is said to offer little resistance to air. be highly efficient, and to be low in cost.



Adsorber is one inch thick and is available in four standard sizes. Installation can be made in existing systems without mechanical change. It is especially suited for low and intermittent odor levels, the company states. When the charcoal becomes saturated, it is changed at the site.

More information? Circle Item 71, postcard, last page.

Underground Pipe Insulations

Three underground pipe insulation systems are offered in the heating and piping field by Concrete Thermal Casings, Inc., Seattle, Wash. The three applications of vermiculite insulating concrete, *CTC*, *Z-Crete*, and *b-t-u*, feature ease of piping insulation at the site, and one will fit the ground conditions and job requirements of any project, the company states.

CTC-cased thermal concrete is designed for jobs where conduits are expected to be covered by water. The nonmetallic casing is said to resist corrosion, and low-water-content insulating concrete is said to prevent water migration. The system is air-testable to prove tightness.

Z-Crete, with a tough vinyl watertight membrane, stable at high temperatures, covering the conduit, is designed for jobs where water stands on the conduit periodically.

A water-resistant monolithic conduit, *b-t-u*, likewise is unaffected by boiling water, and employs the high strength of monolithic insulating concrete. It is especially practical for jobs in dry areas where only rain or irrigation water may occasionally stand over the conduit.

All three systems are fabricated in the field for ease of installation and flexibility of design. Each features a structural concrete base pad for alignment and stability and means for removing accidentally introduced water.

More information? Circle Item 72, postcard, last page.

Flexible Rubber Pipe

Gen-Lok flanged flexible rubber pipe, Series G, with a new method of mating and sealing the pipe faces, is announced by General Rubber Corp., Tenafly, N.J.

Consisting of a single-piece, leakproof tube, and a multi-ply, wire-reinforced body, with integral flanges made of rubber, smooth-finished to form a tight seal against the pipe flanges, pipe requires no gaskets. The rubber flange acts as its own gasket when compressed to form the tight seal, permitting direct metal-to-metal bolting to the pipe.

Pipe is now available in all standard diameters from 1 to 12 inches ID and in any standard F-F (face-to-face) length, for maximum working pressures of either 150 or 250 psig. It can also be used for vacuum service. Covers of the pipe can be furnished to resist corrosion, oils, heat and sunlight.

The line of pipe gives excellent results in piping systems handling abrasive or corrosive liquids or slurries, and also has a wide range of applications in pipe line installations in air conditioning, heating and refrigeration systems for the elimination of the effects of vibration, noise and stresses, the company states.

More information? Circle Item 73, postcard, last page.

Year-Round Electric Conditioning

A line of all-electric, year-round conditioners is announced by Remington Air Conditioning Division, Auburn, N.Y. Units, called Incremental Conditioners and designated Type EK, are designed for existing or projected multi-room buildings.

The conditioners provide air circulation, automatically controlled ventilation, air cleansing, dehumidification, and automatic heating and cooling. Equipment may be

installed initially for heating only. Controls consist of simple *on-off* switch and combination heating-cooling thermostat. Once unit is on, only the thermostat need be adjusted.

Ventilation is provided by a high-pressure centrifugal blower through an automatically controlled, electrically operated, damper. Whenever the air conditioner is off, the damper is closed.

Equipment is offered in three cooling capacities from 9000 to 15,100 Btu per hr and likewise three heating capacities from 8000 to 15,300 Btu per hr. These cooling and heating capacities are available in any combination. All capacities are offered for either 208 or 230-volt, single-phase, current.

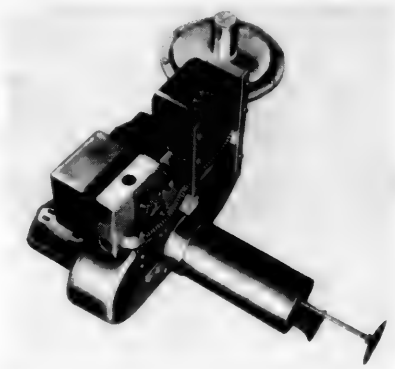
In new buildings, the operating components of the conditioners are installed in a wall cabinet of 16-gage, zinc-coated steel which is put into place at the time of construction. In existing buildings the wall cabinet is placed in the wall after the necessary hole has been cut. The only connection consists of electric wires.

More information? Circle Item 74, postcard, last page.

High-Input Gas Burners

Two power gas burner models providing input capacities to 750,000 and 1,000,000 Btu per hr are introduced by The Nu-Way Corp., Rock Island, Ill. The company states that both models, the G-750 and G-1000, can be installed in any boiler or furnace design with horizontal. revertible flue or in any unit originally designed to be fired with power equipment.

Each of the two models is available with a choice of the following: (1) thermoelectric-type pilot safety with



flash tube ignition of standing-type pilot; (2) electronic pilot safety and flash tube ignition of standing-type pilot; or (3) electronic pilot safety with prepurge and electric, spark-ignited intermittent pilot. According to the manufacturer, the two new models are similar in design to its Models G-200 and G-400 power gas burners, of compact. trim design and with quick-remove panel for ease of servicing all parts.

The two models provide dual control of combustion air so the burners may be installed and then adjusted to conditions of the particular unit being fired. Performance tests are said to have shown this on-the-job primary and secondary air adjustment feature insures quiet operation and permits setting the burner for units with either low or high static drop through flue passes.

More information? Circle Item 75, postcard, last page.

Polyethylene Pipe

Addition of two new lines of polyethylene plastic pipe is announced by Bermico Div., Brown Co., Boston, Mass. Called Bermico SD and Bronco, the pipe will fill out the line, which includes bitumized fiber pipe for drainage and conduit for direct burial electrical wiring

Bermico SD is a nontoxic polyethylene pipe bearing the seal of the National Sanitation Foundation. It is approved for potable liquid use and will find use in jet pump systems for drinking water supply and other uses. A special twin pipe made for jet pump installations is available in 1 to 1½-inch sizes.

Bronco is a polyethylene pipe ideal for farm use, outside sprinkling, irrigation and air circulating systems. Both Bermico SD and Bronco are made in all sizes from ½ to 6-inch diameter. A complete line of fittings is also available for both brands. The plastic pipe will be distributed east of the Rockies only.

More information? Circle Item 76, postcard, last page.

Temperature Indicating Label

A small plastic label, called Temp-Plate, capable of indicating surface temperatures has recently been introduced by Pyrodyne, Inc., Los Angeles, Calif.

Calibrated to give an irreversible registration of temperature, the label is currently available for indication from 100 through 700 deg F in a choice of fifty increments, with a tested indication accuracy of ± 1%. Present development activities are expected to increase the temperature range to 2000 deg, the company states.

The label, backed with adhesive for simple application, registers a permanent change from white to black as the stated temperature level is reached, and will adhere to the mounting surface under a wide range of exposure conditions until intentionally removed. The label will detect over-heating or hot spots on wing surfaces, nozzles, tubing, valves, brakes, radar panels and other critical points where excess temperature presents a hazard.

More information? Circle Item 77, postcard, last page.

Oil and Gas Burner Unit

A fuel burning unit for firing either oil or gas, or a combination of the two, is announced by The Engineer Co., New York, N. Y.

A feature of the air register, which is said to overcome common difficulties, is the easily operated hand-wheel used to control the setting of the air vanes through a chain and sprocket for either clockwise or counterclockwise air rotation. To prevent binding or sticking of the vanes, the shafts on which they are mounted are made of stainless steel, and they turn in carbon graphite bearings. For this reason, it is said, adjustment of the vanes is easier because their shafts cannot become warped or immovable by heat, or bind due to corrosion or rust. Furthermore, it is said that control is precise, without lost motion, particularly in adjusting the vanes when they pass dead center.

The register can be made to fit into any depth of burner housing to suit any fan or duct arrangement with the simplest, and hence lower, installation cost.

Unit is offered with a variety of oil or gas burners including standard range and wide range mechanical atomizing oil burners, steam or air atomizing oil burners, and gas burners of either the ring or gun type.

More information? Circle Item 78, postcard, last page.

Silent Gas Furnace Valve

Development of a silent gas valve, named the Silent Knight, which uses a silicone damping fluid to eliminate the loud clank heard when the thermostat turns on the furnace is announced by White-Rodgers Co., St. Louis, Mo.

A new sound-eliminating principle is used. Usually, gas valves open so quickly that operating parts bang against their retainers, making a loud, irritating clank which is carried along the pipe throughout the house. In cold weather, valves can cycle, and clank, as many as twenty times an hour. In this gas valve, operating parts are slowed down considerably, easing them together and eliminating the sound of them striking one another. Slow opening also tends to eliminate the *pop* caused when a large amount of inrushing gas is suddenly ignited.

By using a silicone oil as a damping fluid, the company has been able to get the desired effect. Petroleum oils are said not to be effective for this purpose because their viscosity changes greatly as temperature varies. Silicones, however, are only slightly affected by wide temperature changes.

More information? Circle Item 79, postcard, last page.

(Continued on page 104)

Unit-Mounted "Packaged" Controls Improve Unit Ventilator Performance

Barber-Colman controls available for all types of unit ventilators... design permits economy of factory installation, allows accurate estimates

Unit-mounted "packaged" control systems for unit ventilators offer important cost and performance advantages:

1. **The complete control system, including the room thermostat, is unit mounted. The wall thermostat is eliminated. Installation cost is lower and factory installation is practical.**
2. **Cost estimating is simplified and becomes more accurate as package controls eliminate many installation variables.**
3. **Control accuracy is improved because a true aspirating principle is employed and thermostat cannot be tampered with by unauthorized personnel.**

Barber-Colman "packaged" control systems, containing all necessary components, interconnecting plug-in wiring and damper linkage, are available for the four basic types of unit ventilators in common use today. The various systems are described in the following paragraphs.

Steam and hot water units utilizing coil valves for control of heat output: Refer to Fig. 1. In this system a unit-mounted room and discharge thermostat controls a motor-operated valve located in the coil supply or return line. This valve, with high rangeability equal percentage throttling plug, adjusts heat output by controlling rate of steam or water flow through the coil, thus providing sensitive and uniform (free from cycling) temperature control. The discharge element insures positive control of discharge temperatures throughout the entire heating and cooling cycle.

A spring-return motor operator, combined with a unit-mounted thermostat, controls damper position. Positive sequencing prevents outside air damper from opening beyond minimum before the coil valve is tightly seated. This assures most economical operation and proper control of discharge temperatures during periods of ventilation and natural cooling.

Hot water units utilizing face and bypass damper control of heating (or cooling) output: Refer to Fig. 2. Controls for these units include a combined unit-mounted room and discharge thermostat and positive positioning motor operator, which act together to position the coil bypass and the outdoor-return air dampers in positive sequence, affording balanced control of both room and discharge temperatures. In units equipped for chilled water cooling, a change-over thermostat senses change in supply water temperature and switches the unit ventilator control system to the appropriate cycle.

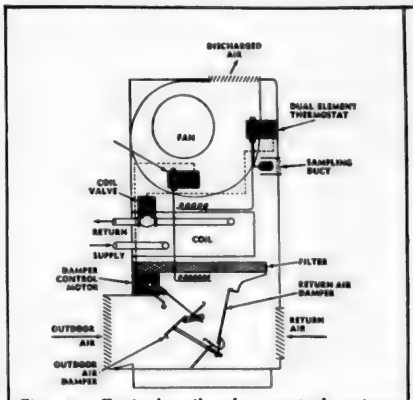


Fig. 1 — Typical coil valve control system.

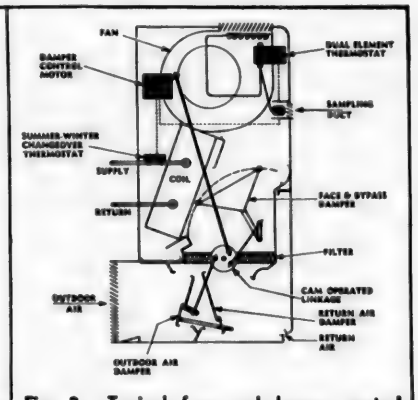


Fig. 2 — Typical face and bypass control system. Shown with change-over thermostat.

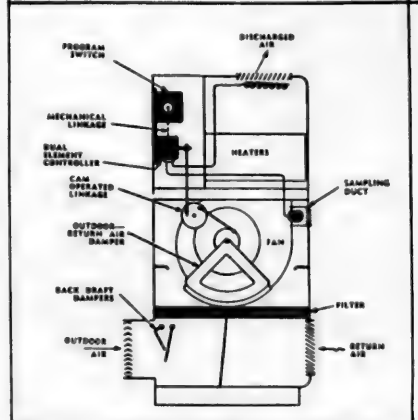


Fig. 3 — Typical electric heat control system.

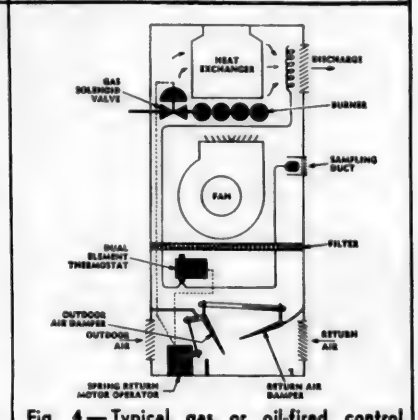


Fig. 4 — Typical gas or oil-fired control system. Shown equipped for gas operation.

Electric heat units: Refer to Fig. 3. A single controller (combined dual-element thermostat, positive-positioning motor operator and heater control switches, all on one chassis) accomplishes smooth system response by positioning the outdoor-return air damper, energizing or de-energizing heaters in increments and opening or closing the fan motor circuit. De-energizing of unit fan motor and heaters during unoccupied periods or on shutdown is automatic.

Gas and oil-fired units: Refer to Fig. 4. A dual-element thermostat and positive-positioning motor operator (advantageously combined in some units) positions the outdoor and return air dampers, and provides time-modulated on-off control of the heat source.

Note: Information on control systems for all large-capacity auditorium-type units is available on request.

Ask for New Application File — Specifications and details on control hook-ups for all leading makes and models of unit ventilators. Call your Barber-Colman representative or write today.

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Announcing:

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The All-New Cordwall

- **It's Off The Floor**
- **It's Flush With The Wall**
- **It Conceals All Plumbing**

It's completely self-contained. It's versatile—can be mounted at any height to accommodate children, youngsters or adults . . . can be installed on the wall, or in semi or full recess. It's compact—saves up to ⅔ of the space required for conventional coolers. And it's modern—a major achievement in water cooler design. Write today for full information on this new concept in water cooler construction.

There are 22 *other* Cordley Electric Drinking Water Coolers, too!

Cordley

CORDLEY & HAYES
443 Fourth Avenue,
New York 16, N. Y.

(Continued from page 102)

Wall-Hung Fountain

An electric water cooler that can be mounted on the wall without exposed brackets or plumbing is offered by Cordley & Hayes, New York, N.Y. Named the Cordwall, its introduction was prompted by the good response to the company's heavy steel bracket, introduced four years ago, which allows wall suspension of standard coolers.

Unit is off the floor, mounted either flush, semi-recessed, or recessed, at any height to accommodate children or adults. Cabinet is neutral grey baked enamel which tapers from a 13-inch depth at the top to 9 inches on the bottom.

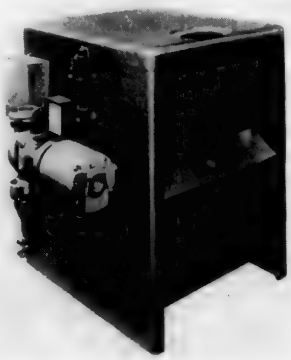
Bubbler's built-in regulator allows uniform fluid flow regardless of water pressure between 20 and 100 psi. A glass filler can be added without removing the top plate.

To install, roughing-in detail is positioned with template included with unit. Then, with heavy steel bracket provided as standard equipment secured to wall, cooler is hung in place and connected.

More information? Circle Item 80, postcard, last page.

Compact Gas-Fired Boilers

Continental Manufacturing Co., Baltimore, Md., announces new Series G gas-fired boilers available for immediate delivery. Seven sizes from 84,000 to 210,000 Btu per hr allow proper heat loss sizing. All sizes are



31 inches high, and are approved for installation on wood floors.

Compact design enables unit to be installed in confined locations. Tankless copper coil for domestic water is optional and can be added later. Units are offered packaged, as shown, to minimize on-the-job labor.

More information? Circle Item 81, postcard, last page.

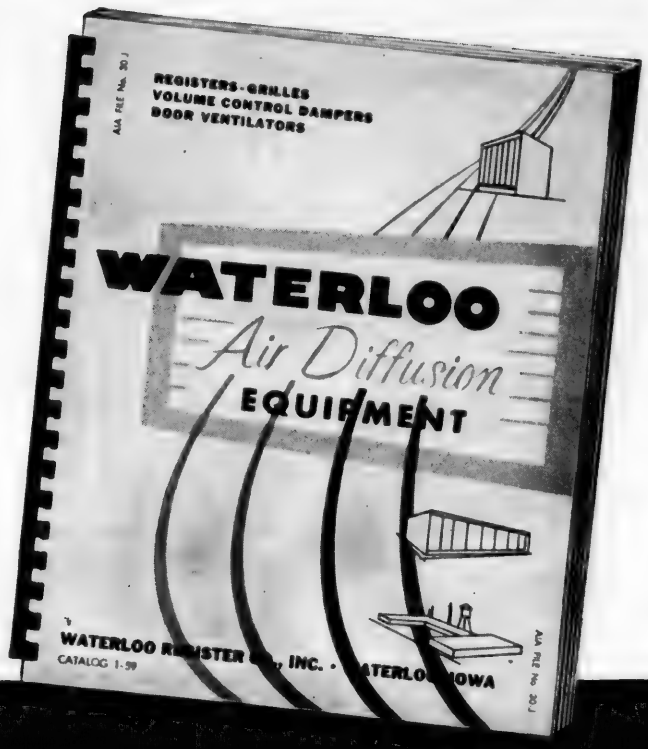
(Continued on page 106)

Announcing

NEW WATERLOO Catalog*

- Fully illustrated
- Color keyed for easy reference
- Contains complete data on wide range line of grilles and registers

This new 58-page Catalog gives you information you need on Waterloo's complete line of return and supply registers, extruded aluminum Airline grilles, removable core grilles, volume control dampers and door ventilators. Each type of unit is well illustrated and keyed in color for quick reference. The catalog contains many recent design developments.



* *Write for your free copy of this comprehensive guide to the quality-built Waterloo line.*

WATERLOO REGISTER COMPANY, INC.

P.O. BOX 72, WATERLOO, IOWA

WATERLOO Air Diffusion EQUIPMENT

WR-113

IMPROVED 30 MODEL, 1,000 THRU

D-H CENTRAL

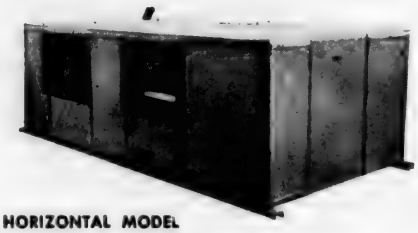
30,000 CFM, H- AND V-SERIES

STATION AIR CON-

ARE MODULAR CONSTRUCTED

DITIONING UNITS

HAVE INSIDE MOTOR MOUNTING



HORIZONTAL MODEL

THE BEST OF PROVED-BEST FEATURES 'N SOME NEW ONES, TOO: SECTIONALIZED CONSTRUCTION. FULL ACCESS TO ALL EXPOSED AREAS. FRAME, STRUCTURAL STEEL ANGLES, WELDED FOR RIGIDITY. FAN SECTION MAY BE FIELD-ROTATED. FANS, FORWARD CURVE, DIDW, CAST IRON CENTER HUB. EXTRA DEEP COIL SECTION CAN ACCOMMODATE 10-ROW COILS. DRAIN CONNECTIONS BOTH ENDS. INSULATED DRAIN PAN INDEPENDENT OF UNIT. SELF-ALIGNING, LIFETIME LUBRICATED BEARINGS. HIGH, LOW VELOCITY FILTERS. SEND FOR TIME-SAVER "FAN PERFORMANCE CURVES."

d-h SINCE 1918

drayer-hanson

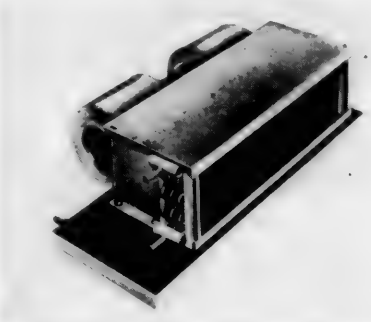
DIVISION NATIONAL U. S. RADIATOR CORP.

3301 MEDFORD STREET
LOS ANGELES 63, CALIFORNIA
CABLE: CLICONI LOS ANGELES

(Continued from page 104)

Horizontal Fan-Coil Unit

A year-round horizontal fan-coil air conditioning unit, for apartments, hotels and motels, is announced by American-Standard Plumbing & Heating Div., New York, N.Y. This unit, Type 30 Remotaire, is designed for use with hot or chilled water in concealed overhead installations, such as in dropped ceilings or closets. With the use of this unit, air conditioning can be removed from the exterior wall, freeing its design, particularly for floor-to-ceiling glass, according to the company.



Fan load and motor speed are carefully matched in the unit for optimum performance at low operating cost. Effective conditioning is assured by the large-surface-area three-row coil. Drain-pan design of the unit offers positive sweat protection.

More information? Circle Item 82, postcard, last page.

High Temperature Exhaust Fans

A line of exhaust ventilating fans, engineered to provide maximum exhaust per horsepower used, is announced by Binks Manufacturing Co., Chicago, Ill. Fans are designed for exhaust hoods and oven air seals, and will function at top efficiency at temperatures ranging from minus 40 to plus 400 deg F, the company states.

Fan housings are available with single mounting ring or with double flush rings. Drive motors are mounted outside the duct on a base which provides belt take-up. Both the V-belt and the fan pulley are enclosed in a dust- and vapor-tight housing. All fans are of the six-blade aero type, precision mounted on a steel shaft which, in turn, revolves on high temperature ball bearings to ensure smooth and efficient operation.

Motor horsepower requirements range from ¼ to 7½. Fan and duct sizes range from 18 to 42 inches. Free air delivery ranges from 3180 to 29,500 cfm.

More information? Circle Item 83, postcard, last page.

(Continued on page 108)

Steel Pipe's in Fashion at Bullock's Santa Ana

General Contractor—C. L. Peck Construction and Realty Company; Plumbing Contractor—Mehring and Hanson Company; Pipe Jobber—Grinnell Co. of the Pacific.

Fashion Square is unique. It's the first large shopping development in the country to be devoted primarily to modern fashion, both in wearing apparel and home décor. Covering 45 acres in Santa Ana, California, it was conceived and built by Bullock's, Inc.

Steel pipe serves Fashion Square's main building, Bullock's Santa Ana, where Beth-Co-Weld was installed for the plumbing and heating lines, vent lines, and in the fire sprinkler system. Today, top builders use steel pipe because it's low in cost, quickly installed, long in service. And Beth-Co-Weld is steel pipe at its best.

On your next job, use Bethlehem steel pipe. You can be sure it will do the best possible job at the most reasonable cost.

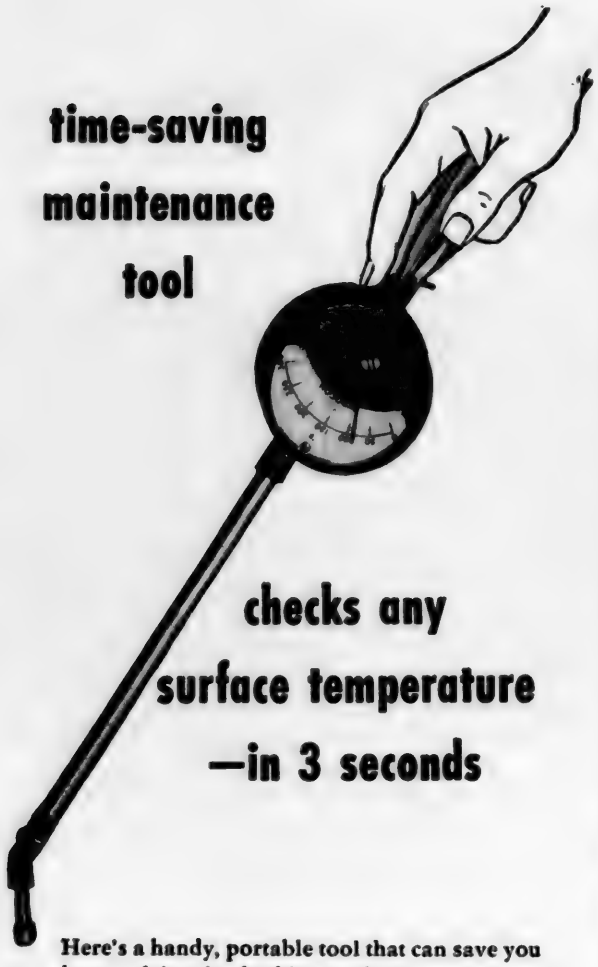
Bethlehem steel pipe works easily, installs fast. Beth-Co-Weld is furnished, black or galvanized, in sizes from ½ to 4 in., nom., and in uniform 21-ft lengths, ± 1-in., as well as in random and cut lengths. Larger diameters are produced by Bethlehem as electric resistance-weld steel pipe.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



Here's a handy, portable tool that can save you hours of time in checking surface temperatures of steam traps, water lines, electric motors, bearings, etc.

The Alnor Pyrocon gives instant, accurate temperature readings of any surface: metallic or non-metallic, flat, curved—even revolving surfaces. It's a well-balanced instrument mounted in a sturdy case for protection against the usual hazards of on-the-job service. Jeweled movement is also heavy-duty, shock-resistant type that will withstand hard and continuous use...performing with laboratory accuracy.

A wide selection of thermocouples and extension arms assures its adaptation to your needs. Eight standard F. scale ranges are available up to 2000° F. Send for complete details contained in Bulletin 4257. Illinois Testing Laboratories, Inc., Room 514, 420 N. LaSalle St., Chicago 10, Ill.

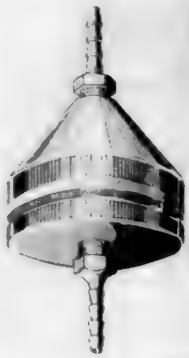
PRECISION INSTRUMENTS
FOR EVERY INDUSTRY

Alnor®

(Continued from page 106)

Filter Holder for Sampling

Gelman Instrument Co., Chelsea, Mich., announces its Stack Sampling filter holder. The filter holder is designed to be used to determine dusts and aerosol concentration in smoke stacks, process ducts and other closed systems.



In use, a high-efficiency dust filter is inserted in the holder and suction is applied to one end. After a dust sample has been collected the filter is removed. Dusts may then be determined by weight or microscopic examination. When used with special membrane filters, dusts may be counted and sized directly on the collecting surface of the filter. Radioactive aerosols may be determined by removing the filter and placing it in a counting chamber. It is possible to determine even weak beta and alpha emitters since the particles are not embedded in the filter material.

Filter holders are supplied in 1, 2, and 3-inch sizes. The body of the filter is constructed of anodized aluminum; the support screen is of stainless steel.

More information? Circle Item 84, postcard, last page.

Heats 30,000-Gallon Pools

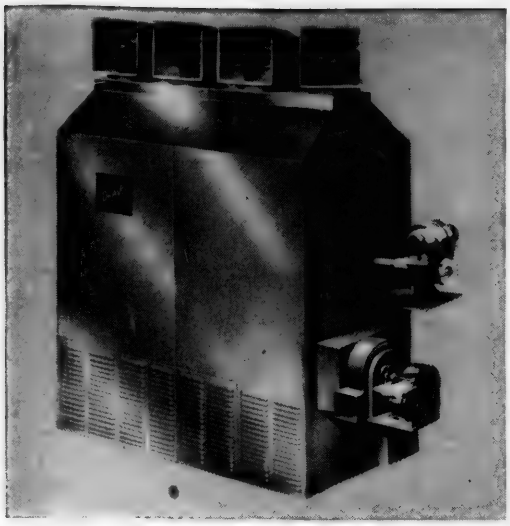
Addition of a gas-fired Burkay swimming pool heater to its line is announced by Permaglas Div., A. O. Smith Corp., Kankakee, Ill. Called the 30F, it is designed for heating pools of approximately 30,000 gal capacity. Rated at 300,000 Btu per hr., it is fully automatic.

A flow switch operates in the following manner: When the filter pump turns on and begins to circulate water through the system, the flow switch activates the heater burner. When water flow subsides, the switch shuts off the burner. In this way, pool temperature is maintained and the heater is in operation only when adequate water is circulating through the system.

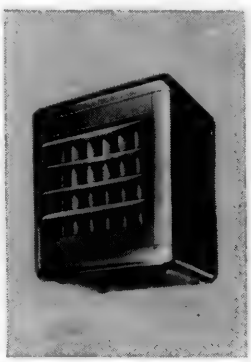
Two thermostats are furnished as standard equipment for correct regulation of the system. The heater is only 66¼ inches high, 25 3/16 inches in diameter. It needs no special support, foundation, or platform. A self-generating electrical system eliminates the need for any wiring or outside supply of current.

More information? Circle Item 85, postcard, last page.

(Continued on page 110)



Dravo *Industrial* heater



Dravo *Paraflo* heater and *Suspended Unit* heater

Dravo *Commercial* heater

ONLY DRAVO HAS ALL 4

1. **FULL LINE**—A size and type for every heating need
2. **DESIGN AND APPLICATION KNOW-HOW**
3. **NATION-WIDE SERVICE**
4. **RESEARCH**

Dravo's full line of heaters is backed by a highly trained and extensive service organization, with a reputation for dependability and thoroughness.

This is only one of the "extras" that benefit Dravo customers. The performance built into every Dravo heater is applied so that each installation functions with maximum efficiency. This is only possible because *every* Dravo technical representative *is a qualified heating engineer.*

Complete research and laboratory facilities conduct continuous studies of heater design problems. With the experience gained from over 10,000 installations, these studies result in basic improvements in all phases of both heater engineering and its application to unusual heating problems.

Make sure you get "ALL 4" when you are buying space heating. Only Dravo has the manpower, the technical background, and the facilities to assure your getting the most for your money. Write Dravo Corporation, Pittsburgh 22, Pennsylvania.

DRAVO
CORPORATION

Quickdraft...THE WORLD'S SAFEST

POWER DRAFT UNIT FOR INDUSTRIAL, RESIDENTIAL AND INSTITUTIONAL EXHAUSTING

Increases heating and combustion efficiency!

Provides air power for bulk materials handling!

Exhausts corrosive gases and abrasives!

Quickdraft provides industry, commerce, institutions and homebuilders *power draft* engineered for economical and efficient combustion regardless of building or atmospheric conditions. Models suitable for every heating or incinerator application . . . eliminate pulsating or chattering, puffing, smoking and sooting. Reduce building costs, no tall, unsightly stacks required. Quickdraft also provides industry with ¼ inch to 60 inches W.G. static pressure for exhausting corrosive gases, abrasives and paint spray. Heavy-duty, high-pressure models, 6 inches to 30 inches diameter, are available for moving bulk materials or anything that can be moved by air. Because there are no motors, fans or bearings in exhaust line, only Quickdraft avoids costly clogging, corrosion of moving parts or fan failure.

IMPORTANT NOTICE

For withstanding corrosive gases, all Quickdraft units are available in standard acid resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P.V.C.) and with plastic and Fiberglas coatings.

N-623-QD

NO MOTORS FANS OR BEARINGS IN EXHAUST LINE

Send for QUICKDRAFT ENGINEERING DATA on your application . . . now.

Quickdraft CORPORATION

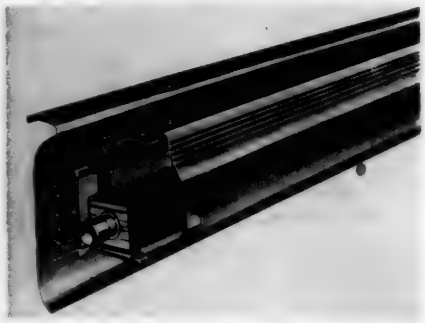
P.O. Box 87— O Canton 1, Ohio

(Continued from page 108)

Half-Inch Baseboard Tubing

A new ½-inch baseboard tubing for zone control hot water heating systems, recently developed by the Edwards Engineering Corp., Pompton Plains, N.J., now offers industry-approved ratings said to be greater than those of standard ¾-inch tubing.

The company's line of baseboard units now includes both the new ½-inch and the standard ¾-inch nominal



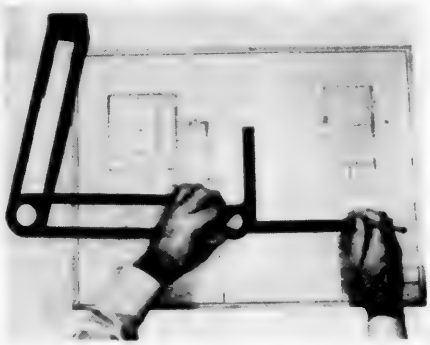
tube sizes plus high-capacity units; all are available in unbroken, factory-cut lengths from 2 to 20 ft for fast, wall-to-wall installation. All covers feature Acousti-cover lining, to minimize noise and are also available in coppertone, chrome, flat white or the new wood-grain finish.

Because of the versatility of the system, it is suitable for every baseboard heating problem, whether in single or multi-zone installations, the manufacturer states.

More information? Circle Item 86, postcard, last page.

Portable Drafting Machine

The Draftette Senior is a larger drafting machine, produced by David Miller & Associates, Beverly Hills, Calif., which, like its smaller predecessor, folds like a jackknife to fit into a briefcase. It can be opened to attach to its drawing board, a desk, or table.



Constructed of aluminum, black anodized, the machine features a one-piece, 6 by 9-inch interchangeable scale with white numerals that will not rub off. It is divided into 16ths or 10/50ths, with a 360-deg protractor.

Unit comes with or without lightweight drawing board.

More information? Circle Item 87, postcard, last page.

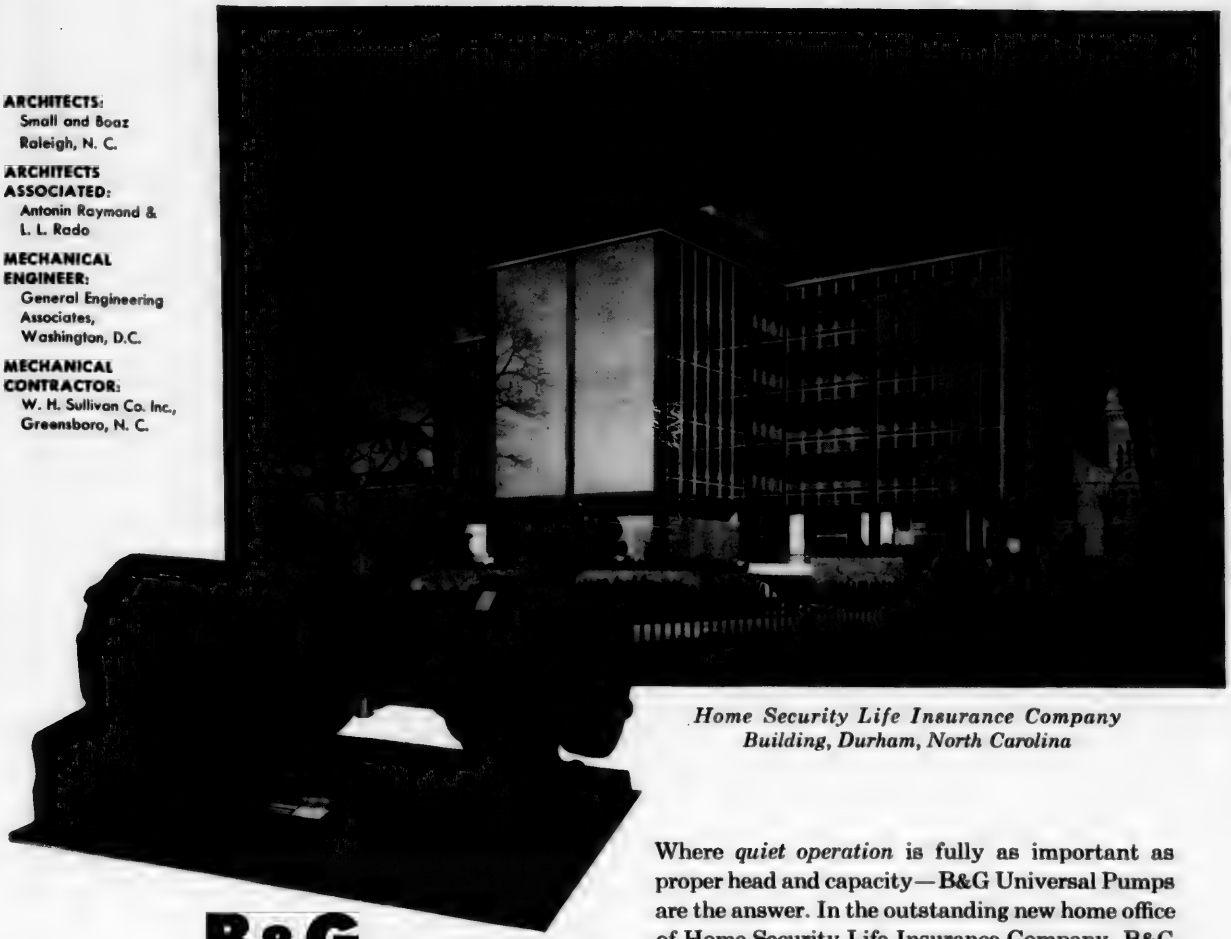
(Continued on page 112)

ARCHITECTS:
Small and Boaz
Raleigh, N. C.

ARCHITECTS ASSOCIATED:
Antonin Raymond & L. L. Rado

MECHANICAL ENGINEER:
General Engineering Associates, Washington, D.C.

MECHANICAL CONTRACTOR:
W. H. Sullivan Co. Inc., Greensboro, N. C.



Home Security Life Insurance Company Building, Durham, North Carolina

B&G

UNIVERSAL PUMPS "COULDN'T BE QUIETER"

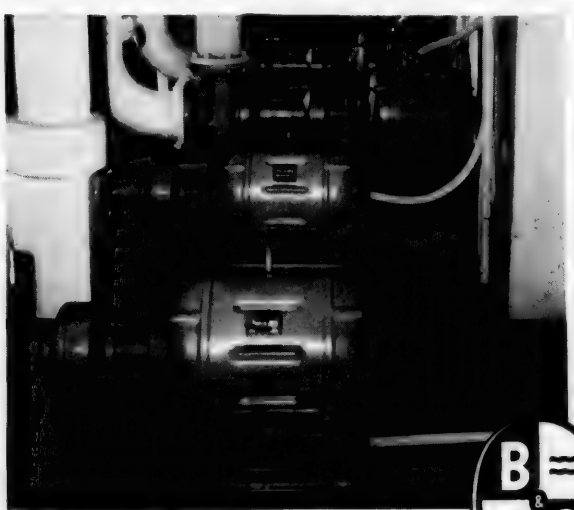
—Says Plant Engineer of system designed for quiet operation

Where *quiet operation* is fully as important as proper head and capacity—B&G Universal Pumps are the answer. In the outstanding new home office of Home Security Life Insurance Company, B&G Universals circulate hot water for heating and chilled water for air conditioning. Says the plant engineer: "We have complete satisfaction—the pumps couldn't be any quieter."

B&G Universal Pumps are designed and built for just one purpose: To meet the exacting demands of circulated water heating and cooling systems *dependably*, *smoothly*, *silently*. To that end they are built with such features as specially built, more costly motors, tested for quietness...oversized shafts of hardened alloy steel...long *sleeve* bearings...noise dampening spring couplers...oil lubrication and leak-proof mechanical seals.

B&G Universal Pumps are of vertical Split-Case construction with removable bearing frames. This allows easy servicing without breaking pipe connections or motor leads.

B&G Universal and Booster Pumps are *preferred* because they're *quiet, where silence counts.*



Battery of B&G Universal Pumps used for circulating heating and cooling water.

BELL & GOSSETT
COMPANY
Dept. FU-4, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

(Continued from page 110)

Improved Diazo

An improved non-reproducible diazo-type intermediate paper is announced by Frederick Post Co., Chicago, Ill. The easily readable phantom blue images on Post 206 PBT prints do not block actinic light, and consequently will not reproduce. However, pencil or ink lines subsequently drawn in over the phantom blue lines do reproduce. Printback speed for the subsequent prints of the pencilled-in data is excellent due to the specially transparentized vellum the company uses, it states.

The paper lends itself to a variety of uses. Marginal information accompanying an original drawing, but not intended to be reproduced for general distribution, may be printed in phantom blue. This supplementary data will not subsequently reproduce; pencil or ink lines drawn or traced over the phantom blue lines will pick up these images on any type of print made later from the PBT intermediate.

A special adaptation of the paper is in the field of special grid, isometric, or cross-section forms which are not available commercially with rulings printed on non-reproducible blue tracing paper. The PBT sheets may be prepared to size from the desired grid papers, and the drawing executed using the phantom blue lines as guides. When reproduced, only the drawing will appear.

More information? Circle Item 88, postcard, last page.

Electronic Air Cleaner

An electronic air cleaner, patterned after units developed for U. S. atomic submarines, is introduced by Trion, Inc., McKees Rocks, Pa. Known as the Model LCT, unit is said to offer "true-plate" type electronic air cleaning.

Designed for horizontal or vertical air flow, and fitted into the return air duct ahead of the furnace and/or air

conditioner, unit needs no water or drain connections. All parts, including the collector cell, can be removed easily from the cabinet for cleaning. The cell can be washed in a tub or hosed down with a common garden hose, dried quickly, and put back into service, all within a matter of minutes, the company states.

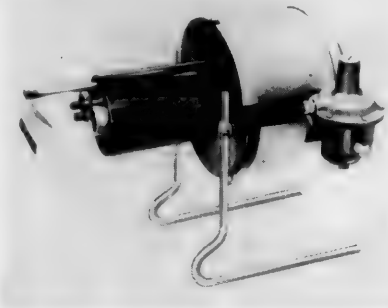
The model boasts an efficiency rating of 90% or better according to the National Bureau of Standards dust-spot method using atmospheric air in the removal of dirt, dust, pollen, germs and other airborne contaminants.

More information? Circle Item 89, postcard, last page.

Gas Conversion Burner

Its Twinshot gas conversion burner, announced by International Heater Co., Utica, N.Y., is said to give great stability of flame and pilot because all combustion air is delivered to the point of use.

Two V-3 burner tubes each have three different gas-air velocities, said to result in unusual flame retention and elimination of turbulence and noise. This tube design



and the flame spreader, the company states, makes it possible to tailor the size and shape of the flame exactly to the available combustion space, whether small, large, round, or square. Burner can be adjusted to meet any condition because its flame pattern is not fixed.

Unit can be mounted in an oil burner flange or be leg-supported. Pilot and burner are rigidly aligned. The entire assembly can be removed without distrubing adjustments. In the majority of cases, unit retains full oil rating of furnace or boiler. Two models are offered, AGA listed: 70,000 and 280,000 Btu input.

More information? Circle Item 90, postcard, last page.

Explosion Type Sewage Grinder

An explosion type sewage grinder, offered by McPherson, Inc., Tampa, Fla., is said to eliminate clogged sewers and unevenly loaded disposal fields.

Unit grinds and aerates sewage. The grinding of normal sewage is accomplished largely by sonic impulses at a frequency of 180,000, finely disintegrating all digestible materials. Material not sonically disintegrated is mechanically ground through a $\frac{3}{8}$-inch clearance by an explosion type grinding action, which action, the company explains, may be compared to a rotary type power lawn mower.

Recommended locations: (1) entering sewer from buildings, such as hotels, factories, military centers, schools, subdivisions, added sewers, etc.; (2) before releasing into stream, pond, or lagoon; (3) before pumps; (4) before surface or sub-surface disposal fields; (5) in existing sewers, to multiply their capacity.

Five units are built, for 4, 6, 8, 10, and 12-inch sewers. Included with machine is motor, reversing switch, magnetic starter, and pipe flanges.

More information? Circle Item 91, postcard, last page.

(Continued on page 114)

At the CANADIAN NATIONAL EXHIBITION, Toronto, Ontario

In the Queen Elizabeth Building

Canadian National Exhibition

POWERS

Regulates the Climate of Progress

In this "most outstanding building of its kind in the British Commonwealth" the proper thermal environment is provided by a Powers Quality System of Air Conditioning Control.

The unique exhibition facilities in the Queen Elizabeth Building have been widely acclaimed as the best and most versatile in Canada. The building also contains one of the Dominion's finest equipped theatres, executive offices for the CNE administrative staff, a branch bank and a large attractive dining room and lounge.

Above: Foyer of Theatre with 1325 seating capacity shown below. (D-14)

Below: Exterior view of Exhibit Hall area.

Architects: PAGE & STEELE, Toronto, Ont.
Mech. Engineers: N. FODOR & ASSOCIATES, LTD.

If You Are Planning a New Building—a school, hospital, factory, church or commercial building, ask your architect or engineer to include a Powers Quality System of Temperature Control. You will benefit from *Powers complete responsibility* for a correctly engineered control system, proper installation, continuous operation with a minimum of repairs—and SERVICE when required from offices in cities from coast to coast.

THE POWERS REGULATOR CO.

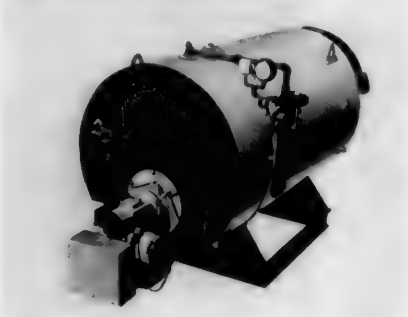
SKOKIE, ILL. | *Offices in 85 cities in U.S.A. and Canada* | *See your Phone Book*

Automatic Temperature and Humidity Control Since 1891

(Continued from page 112)

Steam, Hot Water Generators

A line of packaged scotch-type low pressure steam and hot water generators is announced by National-U. S. Radiator Corp., Johnstown, Pa. To be marketed under the brand name Bonnie Scot, the line is available in 20, 30, 40, 50 and 60-hp models, with net ratings from 499,000 to 1,498,000 Btu per hr.



Designed to meet the demands of a wide range of institutional, commercial and industrial applications where low pressure heating and/or process steam is required, units are available for oil, gas, or combination oil-gas firing. Assembled, wired and tested at the factory, they are shipped ready for immediate operation. Only piping and power connections in the field are required.

Three-pass boiler design provides full 5 sq ft fireside heating surface and 80% thermal efficiency, certified by the manufacturer. Unit is fully "wet back," eliminating the need for rear refractory or suspended arch. Forced draft firing requires no stack or chimney; only a vent to a point of safe discharge is needed.

More information? Circle Item 92, postcard, last page.

Pipe Sealant Tape

A chemically-inert tape designed to seal and to permanently lubricate pipe joints is announced by Minnesota Mining and Manufacturing Co., St. Paul, Minn.

Called "Scotch" brand pipe sealant tape, No. 547, this unfused film tape, available in 3 and 4 mil calipers, can be applied in seconds and conforms to all types of pipe

threads and fittings, according to the company. It can withstand processing temperatures from the liquid-oxygen range through that of super-heated steam. It is not affected by oil traces or other lubricants in the steam line.

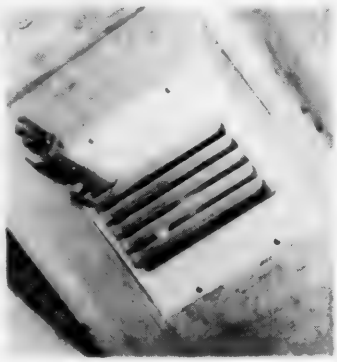
Although non-adhesive, the tape is sufficiently cohesive to stick to its own glossy surface. Its easy application eliminates the need for brushing dope solutions on pipe fittings. It can be applied by one person, and a single wrapping affords full protection. Excess tape can be torn off easily.

This white, pliable tape is available in convenient 36 yard rolls in ¼- to 8-inch widths.

More information? Circle Item 93, postcard, last page.

Thermostat Controls Ventilator

A ventilator, called Thermvent, equipped with a self-contained thermostat which automatically regulates the flow of air according to temperature change, is announced by Zerhan Industries, Inc., Detroit, Mich.



Louvers automatically close in cold weather to prevent heat loss, automatically open in warm weather to allow air circulation for cooling. The units require no wiring or servicing and are said to be maintenance-free. Ventilator has been designed for both residential and commercial use.

Units come in a wide range of sizes and models, ranging from gable, roof, or soffit types to crawl space vents. Fusible link control, which is available on all models, automatically closes the louvers in the event of a fire. Other models open automatically in the event of a fire. The vent mechanism is made of aluminum, and the thermostat mechanism is made of zinc dichromate plated steel. The units are built to standard ventilator opening sizes so they can be installed for use in conjunction with or in place of regular open ventilators.

More information? Circle Item 94, postcard, last page.

New Chemical Improves Insulation

Commercial availability of an amino-silane chemical that reacts with both organic and inorganic materials to unite them in a strong, durable bond has been announced by Dow Corning Corp., Midland, Mich. Identified as Dow Corning Z-6020, the new brown liquid has already been employed to improve the performance of organic materials in a variety of commonplace applications involving glass fibers. Glass or mineral wool insulation, the company explains, has greater resiliency, heat stability, and resistance to the damaging effects of moisture when the agent is added to the binder resins.

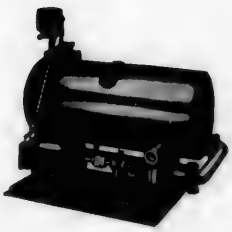
More information? Circle Item 95, postcard, last page.

(Concluded on page 116)

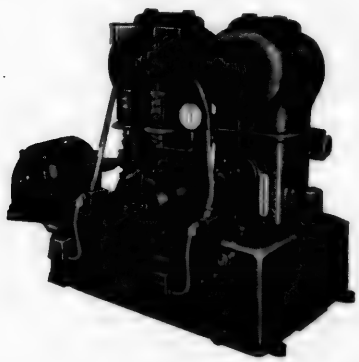
Skidmore Pumps gives PEAK PERFORMANCE — Right Down the Line!

Skidmore Corporation's complete line of heating pumps affords a type and capacity for every general or special installation. Available in both single or duplex units with close-coupled and mechanical shaft-seal. Low installation cost and maintenance with peak performance are assured from every type or size—Right Down the Line.

"UV" TYPE

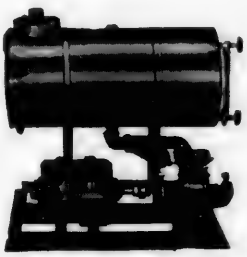


"HS" TYPE



The Skidmore Vacuum and Boiler Feed Pump is famous for "maintained efficiency" . . . liberal clearance between moving parts positively eliminates wear. Capacities range from 5,000 to 100,000 sq. ft. EDR.

SEND FOR BULLETINS



"TM" TURBINE

Sales Representatives in Principal Cities

Since 1921

SKIDMORE PUMPS

SKIDMORE CORPORATION
ST. JOSEPH, MICHIGAN

(Concluded from page 114)

Improved Activated Carbon

Research and development on carbonaceous materials has led National Carbon Co., Cleveland, Ohio, a division of Union Carbide Corporation, to standardize on domestic petroleum-base materials for its complete Columbia line of activated carbon. Imported coconut shell charcoal had previously been regarded as the only acceptable raw material for processing into premium grade activated carbon.

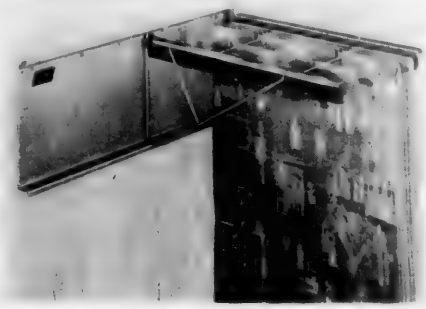
Activated carbon produced from petroleum materials, however, is of comparable or superior quality, the study concludes, and cost reductions are said to have made considerably lower prices possible.

Uses of high-quality activated carbon include air conditioning, gas purification and separation, gas masks, solvent recovery, and as a catalyst support.

More information? Circle Item 96, postcard, last page.

Vertical File for Single Sheets

Plan Hold Corp., South Gate, Calif., announces a re-designed vertical file for single sheets, the simplest and surest yet devised, the firm states. It combines the advantages of vertical filing with the convenience of handling only one sheet at a time. It is a great space saver because 150 individual sheets up to 42 inches wide can be filed in only one lineal foot.



Each sheet is attached to its own aluminum hanger with aluminum foil adhesive fasteners. The hanger is notched to fit a special rack which can be mounted on the wall at a height determined by the length of the sheets to be filed. Once inserted in the rack, the hanger is entirely secure.

In addition to the wall mounted unit, the company offers the extra protection and lock-and-key security of steel cabinets which will accommodate from 165 to 400 single sheet hangers.

More information? Circle Item 97, postcard, last page.

Heavy-Duty Water Heaters

An improved automatic hot water heater with inputs of 190,000, 315,000 and 520,000 Btu is available from Ewing Mfg. Co., Oklahoma City, Okla.

Model 20, only 20 inches in diameter, will raise 180 gph 100 deg F; Model 25, 25 inches in diameter, will handle 300 gal, and Model 31, 31 inches in diameter 500 gal, through the same temperature rise. Storage capacities are respectively, 50, 85, and 145 gal.

The automatic heater operates on all types of gas, has safety pilot control that assures 100% shut-off in case of a pilot failure. Water temperature is controlled by self-generating electric controls. Controls are AGA listed.

All inside surfaces are sandblasted and coated with a metal protective and baked at 500 deg, a process said to assure long life and clear, clean water. Outside shell is ¼-inch boiler plate and ⅜-inch heads. Each heater, after inspection for compliance with ASME Heater and Pressure Vessel Code and stamping, is registered with the National Board of Heater and Pressure Vessel Inspectors.

Specifications and details for Model 25 are as follows: 315,000 Btu input; diameter, 25 inches; height, 77 inches; flues, twenty-one 2-inch by 53-inch, 11 gage; required floor space, 36 inches square; stack size, 10 inches; steel shell ¼-inch thick; pressure relief valve set at 125 lb; thermometer range, 60 to 260 deg F; magnesium rod, 1¼ inches; net weight, 830 lb.

More information? Circle Item 98, postcard, last page.

Plastic-Coated Valves

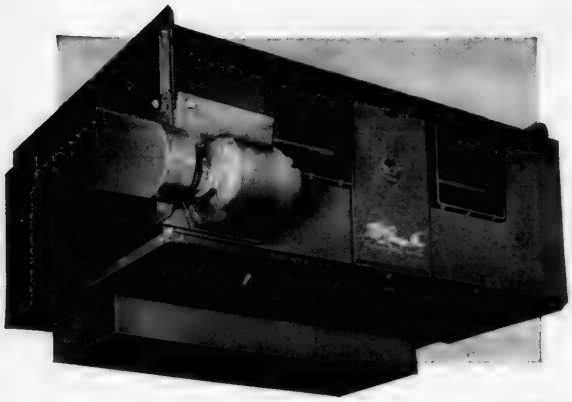
DeZurik Corp., Sartell, Minn., announces that its eccentric valves are now available with plastic coatings. The coatings greatly improve the corrosion resistance of a cast iron valve at only a slight increase in price, the company stated.

Plastic coatings make the valve especially suitable for neutral salt solutions, alkalies, alkaline salts, mild acids

and many other services. They are also an economical answer to iron contamination in water distillation, demineralization, and deionization systems.

The company's valves work on a unique eccentric principle which pivots the plug eccentrically in the valve body to match an eccentrically-raised seat. The plug touches the valve body only when the valve is closed. Plug friction is completely eliminated. Their resilient faced plug eliminates the need for lubrication to achieve tight shut off.

More information? Circle Item 99, postcard, last page.



McQuay "HC" Horizontal heating and ventilating unit. Available in three coil types, standard steam, jet tube steam and hot water.

Flexible for any job
Versatile for any need

THE McQuay LINE OF

HEATING and VENTILATING UNITS

McQuay "HC" Vertical heating and ventilating unit. Also available in three coil types. A full line of accessories is available for all models.

McQuay "HC" heating and ventilating units are the most flexible and versatile available for a wide range of applications, such as schools, churches, hospitals, industrial plants, public and office buildings, and other large area installations requiring quiet, high volume heating and ventilating. They'll handle even the most difficult jobs with ease. Often one McQuay unit will do what normally would require two or more other units. And with McQuay "HC" units come the exclusive Ripple Fin coils and Dura-Frame construction essential to peak performance and economy and quiet, trouble-free operation for years to come. When you have a heating and ventilating problem, call in the McQuay representative or write McQuay, Inc., 1619 Broadway Street N. E., Minneapolis 13, Minnesota.

4 types

19 sizes

1,280 to 48,300 cfm.

26,200 to 2,931,500 Btu./hr.

TV means Quality

McQuay units feature the exclusive Ripple Fin coils which create maximum air turbulence and have wide, full fin collars that act as automatic spacers to form a tube around the coil tube for greatest heat transfer and protection. The Dura-Frame "V" channel construction provides the strength and rigidity necessary for quiet, trouble-free operation.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

DEGREE-DAYS FOR MAY, 1959

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 31st Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31, incl., from Sept. 1		
	1959	1958	Normal	1958-59	1957-58	Normal
Abilene, Texas	8	16	0	2834	3052	2707
Albany, New York	220	322	246	7136	6578	6888
Albuquerque, New Mexico	60	24	70	4117	4396	4389
Alpena, Michigan	344	462	437	7943	7527	7943
Asheville, North Carolina	58	70	105	4075	4726	4067
Atlanta, Georgia	10	29	20	2797	3314	2826
Atlantic City, New Jersey	131	221*	189*	5133	4746*	4717*
Augusta, Georgia	5	19	0	(a)	2936	2138
Baltimore, Maryland	32	46	73	4218	4030	4203
Billings, Montana	436	105	304	6834	6237	6959
Binghamton, New York	211	301	240	6815	6483	6472
Birmingham, Alabama	12	25	30	2839	3258	2788
Bismarck, North Dakota	397	204	355	8986	8030	8851
Block Island, Rhode Island	276	394	335	5803	5411	5720
Boise, Idaho	382	119	249	5254	5362	5798
Boston, Massachusetts	142	262	236	5870	5356	5742
Buffalo, New York	216	343	315	6804	6497	6720
Burlington, Iowa	110	109	179	6222	6236	6067
Burlington, Vermont	260	405	307	8055	7367	7727
Cairo, Illinois	26	48	47	3887	4168	3756
Charleston, South Carolina	0	10	0	1851	2338	1769
Charlotte, North Carolina	13	28	29	3203	3622	3205
Chattanooga, Tennessee	25	40	45	3549	3903	3384
Cheyenne, Wyoming	441	255	462	7104	7028	7317
Chicago, Illinois	114	149*	229*	6249	6053*	6252*
Cincinnati, Ohio	48	67	108	4467	4708	4532
Cleveland, Ohio	133	218	223	6018	5886	5950
Columbia, Missouri	70	72	135	4971	5299	5093
Columbia, South Carolina	5	19	0	2614	3025	2284
Columbus, Ohio	92	107	153	5482	5399	5255
Concord, New Hampshire	235	386	316	7485	6753	7462
Concordia, Kansas	109	67	146	5326	5544	5303
Dallas, Texas	0	6	0	2444	2590	2272
Dayton, Ohio	(a)	148	179	(a)	5825	5552
Denver, Colorado	273	138	286	5805	5666	6051
Des Moines, Iowa	140	98	201	6504	6512	6384
Detroit, Michigan	159	228	251	6423	6150	6336
Devils Lake, North Dakota	458	288	394	9753	8778	9695
Dodge City, Kansas	108	67	135	5114	5313	5043
Dubuque, Iowa	166	183	267	7509	7154	7159
Duluth, Minnesota	467	474	487	9743	8944	9217
Elkins, West Virginia	145	233	224	5914	6286	5680
El Paso, Texas	3	3	0	2409	2761	2641
Ely, Nevada	537	332	418	6857	7253	7177
Escanaba, Michigan	391	483	471	8580	7869	8334
Evansville, Indiana	58	77	90	4689	4946	4354
Fargo, North Dakota	342	237	338	8906	8074	9107
Fort Smith, Arkansas	11	27	24	3423	3564	3188
Fort Wayne, Indiana	140	206	226	6383	6277	6217
Fort Worth, Texas	4	9	5	2553	2806	2361
Fresno, California	59	18	43	2032	2549	2532
Galveston, Texas	0	0	0	1332	1382	1211
Grand Junction, Colorado	104	84	145	5076	5371	5773
Grand Rapids, Michigan	164	252	301	7044	6775	6948
Green Bay, Wisconsin	213	366	347	8349	7823	8062
Greensboro, North Carolina	33	57	50	3908	4321	3810
Greenville, South Carolina	19	30	32	3067	3650	3060
Harrisburg, Pennsylvania	103	148	128	5353	5337	5244
Hartford, Connecticut	173	281	201	6361	5960	6094
Havre, Montana	407	133	313	8200	7223	8030
Helena, Montana	540	167	399	7944	7137	8005
Houston, Texas	0	0	0	(a)	1493	1276
Huron, South Dakota	259	164	279	7893	7274	7796
Indianapolis, Indiana	104	141	176	5760	5824	5581
Jackson, Mississippi	3	16	0	2501	2839	2202
Kansas City, Missouri	56	52	111	4613	5006	4880
Knoxville, Tennessee	30	53	50	3637	4012	3590
La Crosse, Wisconsin	142	152	250	7686	7113	7545
Lander, Wyoming	487	230	396	7581	7343	8110
Lewiston, Maine	242	429	344	7533	6947	7662

(a) Data not available.
* Figures based on City office readings.
Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Co., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively. [Table concluded on page 120]

Made by ALCO
OF CAST IRON AND STEEL
like a Compressor
for LONG RELIABLE LIFE

4-WAY REVERSING VALVES
for all reverse cycle systems

Features:

- fine machining and precision honing of cast iron slide and steel outer shell—NO PLASTICS ARE USED.
- operating tests of 300,000 cycles without failure to shift and without loss of tight seating—tests made by independent laboratories.
- shifting (change cycle) while the system is in operation with a 300 PSI differential.
- rapid shifting—to shorten change-over time and therefore shorten defrost cycle.
- the shifting of the valve independent of any pressure drops, and efficient shifting under any combination of operating conditions.
- mounting in any position—except with the pilot valve upside down.

Call your Alco wholesaler—write for Specifications.

ALCO

- *BUY SECURITY*
- *BUY QUALITY*
- *BUY ALCO*

8077

The one complete line of refrigerant controls: Thermostatic Expansion Valves • Refrigerant Distributors Solenoid Valves • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves

Degree-Days for May, 1959 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 31st Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31, incl., from Sept. 1		
	1959	1958	Normal	1958-59	1957-58	Normal
Lincoln, Nebraska	141	66	172	5683	5807	5826
Little Rock, Arkansas	4	26	18	3034	3227	2982
Los Angeles, California	23	13	68	707	891	1432
Louisville, Kentucky	51	59	94	4408	4727	4434
Lynchburg, Virginia	53	100	82	4160	4664	4148
Macon, Georgia	1	15	0	2173	2607	2049
Madison, Wisconsin	152	221	266	7669	7177	7181
Marquette, Michigan	326	507	477	8268	7819	8184
Memphis, Tennessee	15	36	24	3219	3618	3137
Meridian, Mississippi	2	11	9	2577	2810	2333
Milwaukee, Wisconsin	215	291	351	7402	7150	7044
Minneapolis, Minnesota	192	169	259	7566	7223	7748
Moline, Illinois	114	125	199	6442	6514	6311
Montgomery, Alabama	2	17	0	2173	2615	2137
Nashville, Tennessee	35	56	43	3757	4151	3513
New Haven, Connecticut	193	342	261	5986	5682	5956
New Orleans, Louisiana	0	0	0	1298	1555	1175
New York, New York	129	205	153	5110	4909	5032
Newark, New Jersey	101	188	148	5152	4990	5241
Norfolk, Virginia	37	44	59	3339	3699	3454
North Platte, Nebraska	224	137	243	6623	6719	6470
Oak Ridge, Tennessee	36	48	58	3916	4065	4028
Oakland, California	169	101	212	2067	2395	2883
Oklahoma City, Oklahoma	27	24	38	3887	4139	3519
Omaha, Nebraska	136	63	175	6083	6061	6123
Parkersburg, West Virginia	79	113	119	5000	5178	4737
Peoria, Illinois	103	114	192	6107	6052	6035
Philadelphia, Pennsylvania	70	120	93	4620	4588	4523
Phoenix, Arizona	3	0	0	1115	1437	1492
Pittsburgh, Pennsylvania	95	138	137	5258	5297	5035
Pittsfield, Massachusetts	287	413	336	7585	7177	7501
Pocatello, Idaho	472	155	317	6283	6552	6840
Portland, Maine	295	430	394	7685	6774	7493
Portland, Oregon	259	98	199	3731	3510	4046
Providence, Rhode Island	180	309	258	6073	5669	6041
Pueblo, Colorado	140	78	203	5400	5276	5682
Raleigh, North Carolina	26	41	29	3546	3937	3075
Rapid City, South Dakota	352	129	357	6941	6565	7331
Reading, Pennsylvania	85	149	123	5137	5061	5044
Red Bluff, California	57	24	51	1920	2799	2546
Reno, Nevada	415	176	318	5431	5660	5783
Richmond, Virginia	44	70	66	3913	4314	3955
Rochester, New York	235	337	289	6973	6652	6766
Roswell, New Mexico	11	16	28	3551	3637	3424
Sacramento, California	67	27	85	1827	2492	2595
St. Joseph, Missouri	87	69	101	5423	5654	4692
St. Louis, Missouri	57	59	94	4519	4795	4462
Salt Lake City, Utah	296	106	233	5263	5512	5785
San Antonio, Texas	0	0	0	1768	1816	1579
San Diego, California	25	11	97	701	849	1513
Sandusky, Ohio	151	202	217	6081	5962	5818
San Francisco, California	247	171	248	1897	2169	2523
Sault Ste. Marie, Michigan	436	595	499	9231	8392	9016
Savannah, Georgia	0	14	0	1884	2409	1710
Scranton, Pennsylvania	167	268	196	6492	6408	5994
Seattle, Washington	280	116	246	3998	3524	4237
Sheridan, Wyoming	488	163	387	7622	6793	7674
Shreveport, Louisiana	0	4	0	2392	2472	2117
Sioux City, Iowa	166	83	228	6818	6562	6933
Spokane, Washington	441	143	330	6373	5773	6661
Springfield, Illinois	89	98	127	5566	5672	5211
Springfield, Missouri	63	68	118	4589	4918	4669
Syracuse, New York	222	330	247	7016	6602	6454
Toledo, Ohio	136	233	245	6477	6299	6322
Topeka, Kansas	92	56	112	5190	5101	4906
Trenton, New Jersey	108	161	133	5148	4973	5057
Tulsa, Oklahoma	20	23	44	3606	3877	3584
Utica, New York	166	343	253	6883	6650	6796
Valentine, Nebraska	315	148	288	7191	6925	6971
Walla Walla, Washington	260	71	171	4555	4212	4810
Washington, D. C.	46	67	80	4202	4474	4258
Wichita, Kansas	62	44	101	4689	4984	4564
Williston, North Dakota	403	189	360	8850	7849	8859
Winnemucca, Nevada	484	206	299	6038	6127	6241
Yakima, Washington	365	112	205	5804	5255	5785

For footnotes, see page 118.

JENKINS

O.S.&Y. U-BOLT GATE

MADE BETTER THAN NEED BE...

Costs Less to Use

YOU PAY NO MORE for the extra quality you see in every part of a Jenkins Outside Screw & Yoke U-Bolt Gate valve. Yet longer life and reduced maintenance is bound to result from the extra ruggedness, the precision manufacture and unique design features which Jenkins puts into these popular, general utility valves.

Choose the Outside Screw & Yoke pattern for services where spindle threads must be kept out of the destructive effects of fluids in the line; where spindle threads must be cleaned and lubricated regularly or where a rising spindle is needed to indicate wedge position.

Choose JENKINS, whether O.S. & Y. or Inside Screw pattern, for valves built to save maintenance dollars.

WIDE RANGE OF JENKINS U-BOLT GATES

GET FOLDER NO. 207 which describes Inside Screw and O.S. & Y. patterns . . . Iron Body with Bronze or Stainless Steel Mounting . . . All-Iron and Ni-Resist with type 316 Stainless Steel trim. Ask your local Jenkins Distributor or write Jenkins Bros., 100 Park Avenue, New York 17.

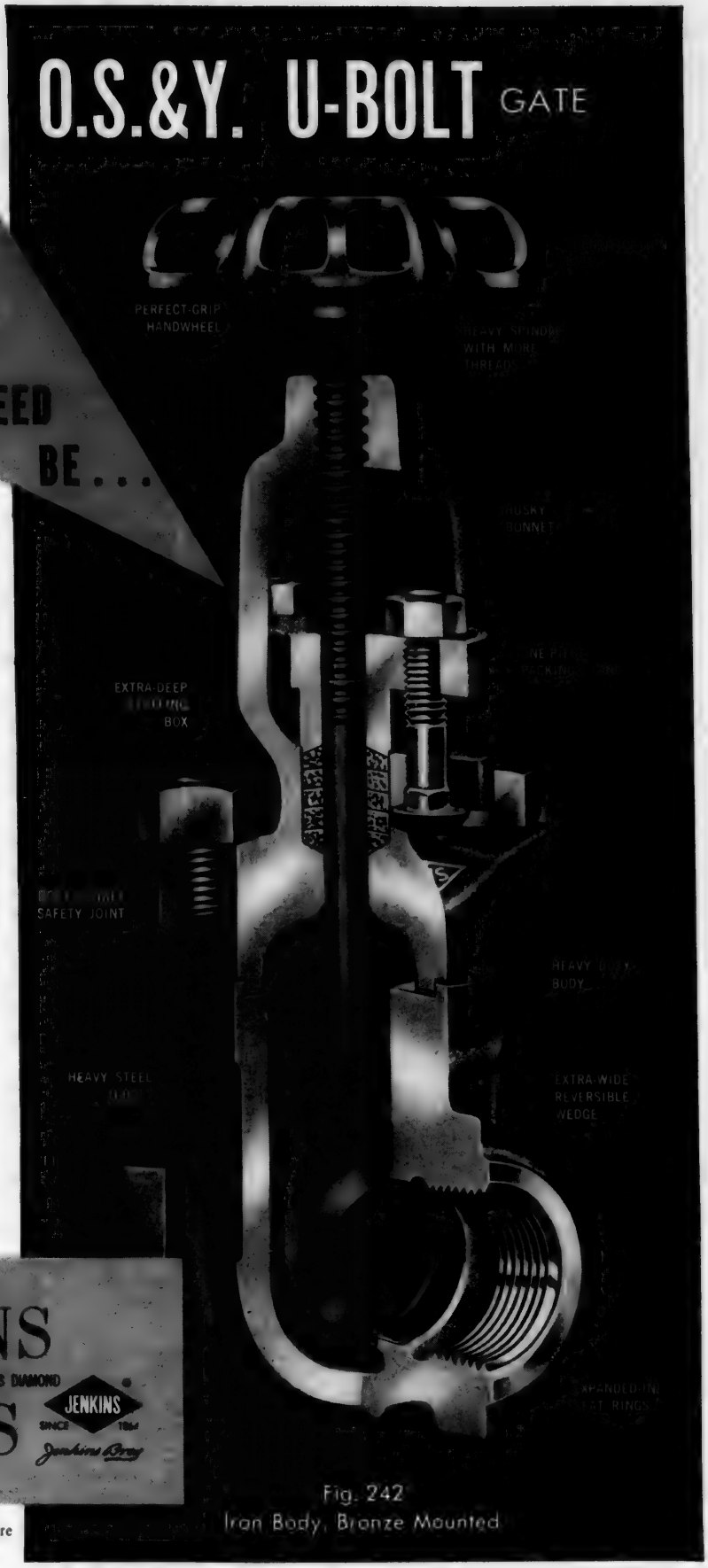


Fig. 242
Iron Body, Bronze Mounted

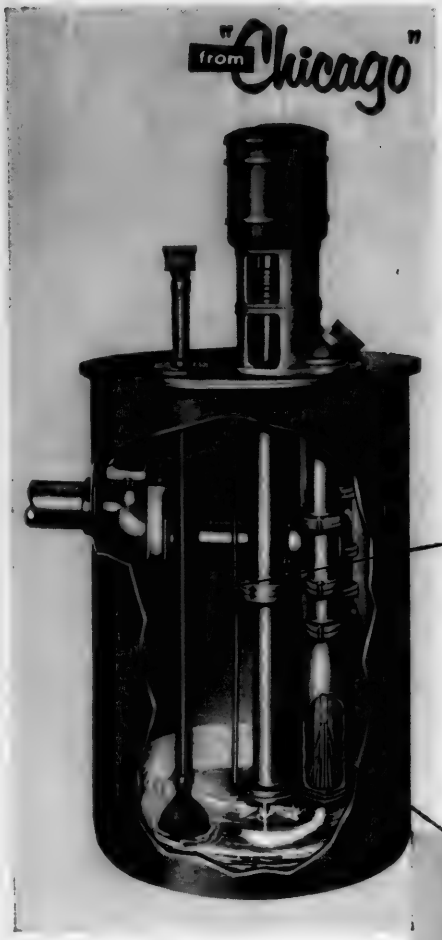
JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864

Jenkins Bros.

Sold Through Leading Distributors Everywhere



. . . the NEW FLUSH KLEEN® story

better than ever FLUSH KLEEN® clog-proof sewage pumping

NOW available with . . .

New SEALTRODE*
Sealed Electrode Floatless Pump Controller . . . the *only* pump controller *completely* free of becoming insulated or coated with grease or corrosive elements found in sewage and drainage water.

New FLO-THRU* Strainer
. . . the heart of the FLUSH KLEEN® System, is now available with FLUSH KLEEN® Sewage Pumps. Clear liquid flows continuously around and through the strainer without obstruction . . . at maximum solids loading.

High Wet Strength Paper Products and other solids . . . are never a problem.

Other Features

- Pumps handle clear liquid only
- Dependable, trouble-free pumping performance
- Minimum maintenance
- 100% standby capacity
- Longer pump life

OVER 13,000 FLUSH KLEEN® INSTALLATIONS

1959 50 YEARS CHICAGO PUMP COMPANY 1909

*Trademark

Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

6221 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

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BRIEFLY STATED NEWS ITEMS

A network of telephone answering services, called ANSWER AMERICA, with headquarters in Chicago, Ill., will offer service on a nationwide basis, covering the United States, Canada, and Mexico. To date, 193 telephone answering exchanges in principal cities and smaller communities have been franchised. Before the end of the year, affiliates in 500 communities are expected. The service will enable air conditioning and heating firms, for instance, to have local representation in each of these areas. They will be able to have telephone directory listings in each community in both white and yellow sections of the directory.

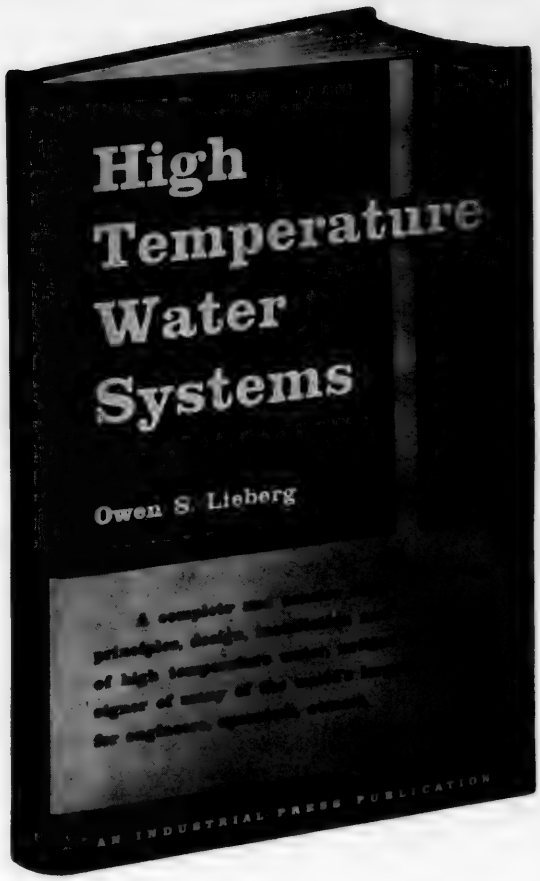
WITH THE ENGINEERS

At their recent annual meeting, the stockholders of ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC., Detroit, Mich., elected V. C. Wagner, a vice-president of the firm for the past three years, to the seven-man Board of Directors of the 65-year-old organization. Incumbent directors re-elected at the meeting, held in the Recess Club, include: Geo. H. Miehls, Sol King, Sheldon Marston, G. K. Scrymgeour, R. E. Linton, and G. S. Whittaker. Executive officers elected by the Board for the ensuing year are as follows: Geo. H. Miehls, chairman and treasurer; Sol King, president; Sheldon Marston, executive vice-president; G. K. Scrymgeour, vice-president and secretary; R. E. Linton, G. S. Whittaker, V. C. Wagner, and Saul Saulson, vice-presidents. . .

FRED S. DUBIN ASSOCIATES, consulting engineers of Hartford, Conn., recently opened a consulting engineering office in San Juan, Puerto Rico, with Victor M. Garcia in charge, for the practice of mechanical, electrical, sanitary and structural engineering. Among the interesting projects in Puerto Rico and the West Indies now being handled are a new hotel in the British

(Continued on page 124)

NEW • COMPLETE AUTHORITATIVE



HIGH TEMPERATURE WATER SYSTEMS meets the need for an authoritative explanation of the principles, design and operation of high temperature water (HTW) systems.

The author is a distinguished international authority who served as consultant on the largest HTW system in England (Bicester Ordnance Depot) and such U.S. installations as the Forbes and Olmstead Air Force Bases and the Cross factory in Detroit. He also designed the HTW system for the largest military establishment in Canada.

The book contains original design data used successfully in actual systems. Tables, graphs, photographs and specifications serve as a working guide . . . and let you benefit from Mr. Lieberg's knowledge and experience.

A special feature is a full-chapter treatment of the design of a typical system . . . step by step . . . based on the principles developed in the book. After mastering this procedure, the engineer will have little difficulty in completing the design of *any* HTW system!

CONTENTS

1. **Advantages of High Temperature Water**
   Arguments for HTW. Brief history. Sample calculation comparing HTW to steam.
2. **Thermal Properties of Water**
   Basic thermodynamics. Units defined. Property tables for water and steam.
3. **Some Design Considerations**
   Temperature drop, system pressure, thermal storage, system flexibility, secondary steam.
4. **Pressurizing the System**
   Reviews pressurizing methods: Steam, air, inert gas. Special cases; heat-power systems.
5. **Boilers and Expansion Tanks**
   Boiler selection. Water tube boilers. Summer load conditions. Sizing expansion tanks. Nitrogen pressure tanks.
6. **Controlling the System**
   Combustion control for various fuels. Control panels. Water level and flow control. Btu meters.
7. **System Circulation Pumps**
   Great detail covering the "heart of the system." Guarding against flashing. Pump specs. Friction heads. Parallel pumps. Auxiliaries, drives, piping.
8. **Valves**
   Valve types and selection. Materials. Emergency closing valves. Valve sizing. Venting by air bottles.
9. **Piping**
   Heat flow capacity of pipes. Design temperature drop. Expansion loops and joints. Pipe sizing and insulation.
10. **Process Heating**
    HTW for process heating. Heat exchangers and converters. Valving and control for process.
11. **Space Heating with HTW**
    Unit heaters. Fan-coil systems. Radiant panels. Complete with application data for all systems.
12. **Applications**
    Describes numerous military and civilian installations in U. S., Canada, and Europe. Economic and design comparison with low temperature water and steam systems for similar situations.
13. **Designing a Typical System**
    Ten-step design procedure for any HTW system. Theory and practice summarized and applied to complete design example.
14. **Appendix**
    A complete specification of a typical boiler plant and auxiliaries for a high temperature water system.

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y.

Please send me ..... copies of High Temperature Water Systems.

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224 pages, 109 illustrations
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ALL SHIPPED IN DISPENSER-TYPE CARTONS

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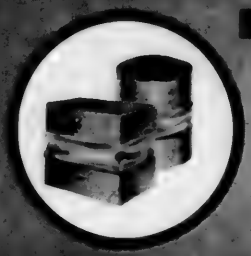
COILS OF PROFIT

Quick, Economical, Easy, and Practical Methods for - - -

FABRICATING FLEXIBLE DUCT CONNECTIONS
VANES FOR ELBOWS • AIR SCOOPS AND LOUVERS



PRE-FAB-RIC

A PREFABRICATED FLEXIBLE DUCT CONNECTION

Using a fabric (of your choice) in the center with a galvanized metal strip on each side. *Double-Safe Locked* together in a single continuous piece, coiled in a dispenser-type carton ready for use

A TYPE, SIZE, AND PRICE FOR ALL JOBS

THREE GRADES
Commercial - Economy
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THREE FABRICS
Canvas - Asbestos
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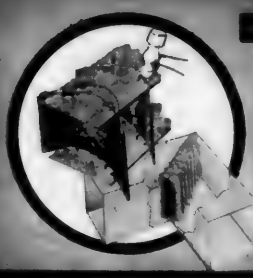
FAB-RIC

TOP QUALITY FABRICS (Without Metal)
Same Weight and Width (5") Used in PRE-FAB-RIC. Put Up in 100' Rolls



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ELIMINATES

Layout, Tab Cutting, Hole Punching, Spot Welding, Riveting, Etc., Results in a Savings Up to 70% over old methods.

Best method ever devised for installing turning vanes (single or double) in sq. elbows.

100 FT. COILS

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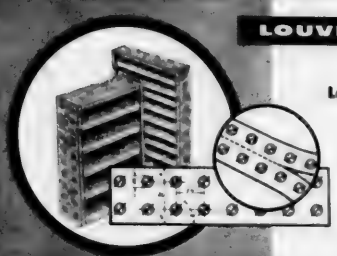


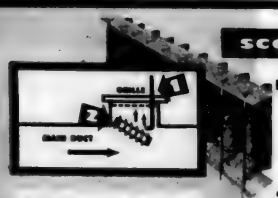
LOUVERAIL

ELIMINATES

Layout, Tab Cutting, Hole Punching, Riveting, Spot Welding, Etc.

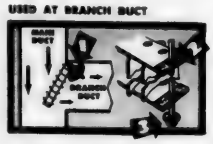
AN ECONOMICAL AND PRACTICAL METHOD FOR FABRICATING LOUVERS — REMOVABLE, HINGED, OR STATIONARY. LOUVERAIL is 24 ga. galvanized 4½" wide in (2—50' lengths) 1 right and 1 left coiled together.

Split (½) Rail for Louver Thicknesses From 1¼" to 1¾"
Use Full Size Rail for Louver Thicknesses From 3¼" to 4"



SCOOP-RAIL

ELIMINATES —
- Radius oil, transition, and splitter damper at branch duct take-offs.
- Volume damper on grille.
- Job delay in ordering.



USED AT BRANCH DUCT

1. Not necessary to remove grille to adjust volume. Use bent rod or wire thru grille to adjust unit in and out of main duct.
2. S. M. screws at top and bottom.

SCOOP-RAIL for fabricating air scoops for branch ducts and grille collars. Insuring uniform air distribution. Complete control of air volume in branch duct or at grille face. Simplifies balancing of the system.

1. ¾" standard quadrant where accessible.
2. Speed nut tabs for ⅜" square rod are riveted, spotwelded or s. m. screwed to ends of SCOOP-RAIL.
3. Where desired clg. control may be used.

CAIN MANUFACTURING, Inc.
Birmingham, Alabama
3911 North 6th Ave. . . . Phone FA 3-0884

Briefly Stated

(Continued from page 122)

Isle of St. Kitts, which includes a full power generation plant, a distilled water installation system, and complete air conditioning system for 110 rooms; a 40 room addition and new night club for the Virgin Isle Hotel in St. Thomas; the complete mechanical and electrical system, for the new 120 room Coral Beach Hotel in San Juan, a new Library in Mayaguez, Puerto Rico; San Ignacio Residence Hall; and new Movie Studio outside of San Juan, Puerto Rico. . .

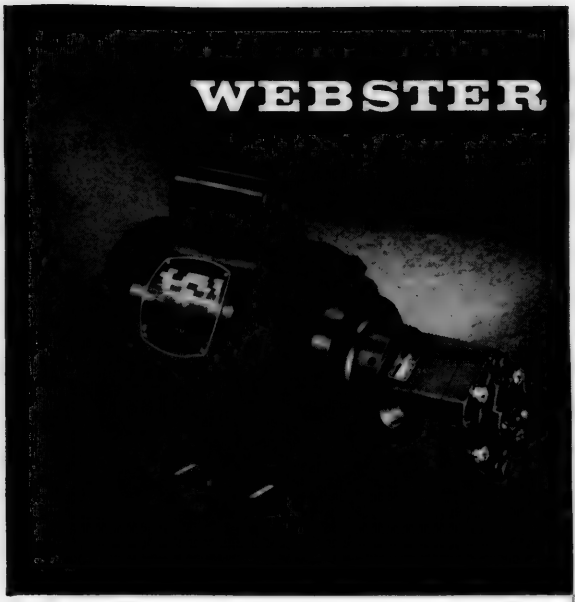
Appointment of John P. Magos as director of engineering for CRANE Co., Chicago, Ill., was announced. Mr. Magos replaces Dr. Maurice Nelles who resigned as vice-president of engineering. . .

Appointment of Joseph J. Jacobs as assistant chief engineer of the West Allis pump department of the General Products Division has been announced by ALLIS-CHALMERS MFG. CO. He started as a design engineer in the pump department in 1940 and was engineer-in-charge of design for three years prior to being named to his new post. . .

Robert W. Ayling has been named engineering section manager, large compressors, at the WESTINGHOUSE ELECTRIC CORPORATION'S air conditioning division in Staunton, Va. Mr. Ayling will work as a member of the compressor engineering team that includes Erik H. Jensen, engineering section manager, small compressors; and John L. Ditzler, manager, research. He will report to Thurman L. Rundlett, division engineering manager. . .

Jack Harris has been elevated to the newly created post of executive engineer of THE KORFUND CO., INC., after serving for twenty years as chief engineer. He will continue to headquarter at the firm's main plant in Long Island City, N. Y. In his new post, Mr. Harris will devote much of his time aiding the company's field engineers when they require his experience to

(Continued on page 126)



SUPPLY PUMPS

Capacities to 575 GPH

This is the way to handle all furnace oils, especially heavy no. 5 and 6 grades — with an extra measure of dependability required for commercial and industrial applications. Webster supply pumps are motor equipped, provide a range of capacities from 15 GPH to 575 GPH. Heavy oil models have extra large ports to transfer initially cold, heavy oils without restriction.

Webster pumps are compact, easy to install. Require less plumbing. Engineering bulletins give complete specifications and mounting dimensions.

call the man from Webster

MODEL 23118 fills the need for a lightweight, portable pump and motor combination. Transfers fuel oil, kerosene or other lubricating liquids. Mounted on wood base, with carrying handle and 25-foot cord.

HEATING DIVISION
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Airsan Viro Crimp
HIGH VELOCITY AIR FILTERS

VIRO CRIMP MEDIA
has special Hemmed Edges for strength and safe, easy handling. No Cuts! No Scratches! No Filter surface damage.

AFI MEMBER AIR FILTER INSTITUTE

- MAXIMUM EFFICIENCY AT (300 — 600 FPM)
- MINIMUM RESISTANCE
- NO DIRECT AIR PASSAGE
- LARGE DUST HOLDING CAPACITY

Also Available . . .
Low Velocity and Grease Filters.
Write for catalogs and prices.

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A few distributorships available.
Write for details!

Concrete Thermal Casings, Inc.

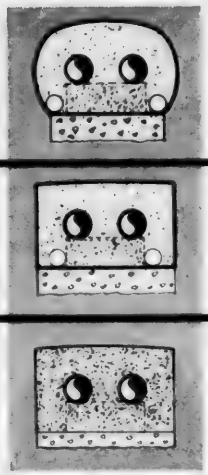
announces

three improved

customized systems of

UNDERGROUND PIPE INSULATION

available through your certified CTC Contractor



CTC

CASED THERMAL CONCRETE

For your jobs in which water is expected to be over the conduit.

MEETS GOVERNMENT SPECIFICATIONS

"Zcrete"

INSULATING CONCRETE CONDUIT

For your jobs in which water may be over the conduit periodically.

b-t-u

WATER RESISTANT MONOLITHIC CONDUIT

For your jobs in which rain or irrigation water may stand over conduit occasionally.

ALL THREE provide ease of piping installation on "sidewalk" base pad; line and grade assured; hard working surface in any weather.

ALL THREE provide the time proven permanence of insulating concrete, field fabricated for design flexibility; changes in alignment easily made during construction; virtual freedom from corrosion problems; non-metallic conduit.

ALL THREE afford speedy installation with a minimum of prefabrication delay by certified contractors who assume undivided responsibility.

ONE of these widely successful conduit systems is the right choice for particular sub-surface conditions and job engineering requirements.

FOR QUICK FACTS

to help choose the system matched to necessary performance or cost factors, ask for Bulletin B, including list of certified CTC Contractors.

CONCRETE THERMAL CASINGS, Inc.

2107 NO. 34TH STREET • SEATTLE 3, WASHINGTON

3020 Grant St., Evanston, Ill. P. O. Box 267, Canton, Mass.

Briefly Stated

(Continued from page 124)

recommend solutions for unusual noise, shock or vibration problems they encounter. . .

Election of Bernhard Willach as vice-president for engineering has been announced by MARSH INSTRUMENT CO., Skokie, Ill. Mr. Willach, who received his engineering degree from Cologne University, has devoted thirty-three years to the design of pressure gages and similar instruments. During the past seventeen years he has been chief engineer of the company. . .

Harold A. Lockhart, vice-president in charge of engineering for BELL & GOSSETT CO., Morton Grove, Ill., was honored for his twenty-five years of service with the company. In a special reception held at the company's Morton Grove plant, Mr. Lockhart was presented a gold watch and a 25-year service pin for his many contributions toward the company's advances in heating and air conditioning. He joined the company in 1934 as a member of the engineering staff and was elected a vice-president and member of the board of directors in 1953. . .

H. D. CONKEY & CO., Mendota, Ill., announces the election of A. B. Carlson to the office of engineering vice-president. Mr. Carlson has been with the organization for twenty-four years, serving in recent years as chief engineer.

WITH THE INSTITUTES

Marcel R. (Dick) Martin has joined the Engineering Department staff of AIR-CONDITIONING AND REFRIGERATION INSTITUTE as assistant engineer, it is announced by Frederick J. Reed, chief engineer of ARI. Mr. Martin will assist Mr. Reed in his work with the engineering and standards committees of ARI product-sections on standards, certification programs, and other technical matters, as well as other activities of the Engineering Department, such as the preparation of technical booklets and releases, liaison with technical societies and trade associations. . .

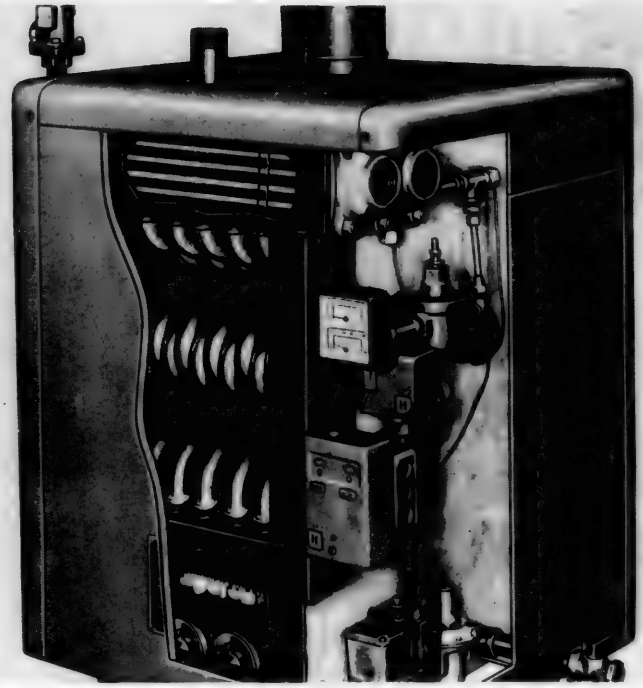
Briefly Stated

The largest Spring Meeting in the history of the FLUID CONTROLS INSTITUTE, INC. was held at the Mid-Ocean Club, Tucker's Town, Bermuda on May 3, 4 and 5. Sixty-seven members, wives, and guests were present representing all promnent manufacturers of automatic regulator valves, control valves, solenoid valves, space heating specialties, steam and gas traps, and steam heating pumps. The following officers were elected at the meeting to serve for the coming year: President, James Lawler, Jr., Lawler Automatic Controls, Inc.; First vice-president, Fred Weldon, General Controls Co.; Second vice-president, Robert McCormick, Automatic Switch Co.; Treasurer, Paul Rogers, Jr.; Skinner-Chuck Co.; Corporate Secretary, Eric Bianchi, Mason-Neilan, Div. Worthington Corp.; Executive Secretary, E. R. Rath, Fluid Controls Institute, Inc. The Fall Meeting of the Institute will be held at The Drake Hotel, Chicago, on November 23, 24, 25.

BURGEONING BUSINESS

H. D. CONKEY & Co., Mendota, Ill., announces, as a part of its acquisition and product expansion program, purchase of the assets of the Spartan Tool Co., Chicago, manufacturers of power-driven drain and sewer line cleaning machines, sewer cable, and cutting tools. The purchase coincides with the retirement of John O'Brien, principal owner of Spartan. His two sons, Patrick and John, Jr., have joined the Conkey organization, and will continue in management positions in the Spartan division. Production facilities and personnel at 1918 Columbia Avenue, will be retained, with John O'Brien, Jr. continuing as plant manager and Patrick O'Brien as sales manager. . .

ARVIN INDUSTRIES, INC., Columbus, Ind., for many years a producer of portable electric heaters, enters the electric home heating field this month. It will offer a full line of radiant, fan-forced, and baseboard heating systems. Entry of Arvin in the primary home heating field was prompted by a belief that electric home heating rapidly



Here's an Efficient, Economical Water Heater. Oil or Gas Fired

No matter how small or how large your requirements, there's a Bryan Indirect water heater engineered to meet your specific hot water needs. Utilizing the Indirect "heat exchanger" method, the Bryan water heater . . .

Provides low cost hot water. The heat exchanger—constructed of heavy gauge copper tubing—is placed in the hot boiler water, absorbs the heat, transferring it to the water flowing through the heat exchanger tubes. Result: a highly efficient water heating system that's. . .

Economical. Since service water does not come into contact with high temperature boiler heating surfaces, there is little danger of scale or corrosion. Thus, maintenance and replacement costs are greatly reduced, and unit continues to perform at maximum efficiency.

Compact. Bryan Indirect water heaters require a minimum of valuable floor space. For example, the model shown, which has an input of 125,000 BTU's, requires only 25" x 23" floor space.

Capacities from 120 gallons to 2160 gallons per hour at 100° rise.

Bryan Indirect water heaters are designed and built to the requirements of the A.S.M.E. code. Gas Fired Models A.G.A. approved.

For information about the specific heater best suited to your requirements, write Bryan Steam Corporation, Peru, Indiana, for catalog.

BRYAN STEAM CORP. • Peru, Ind.

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CONTROL

install

FLEXAUST®

HOSE

Made of strong neoprene coated cotton or nylon fabrics spiral wire reinforced.
For *all* kinds of fume and dust control, and ventilation uses.
Extremely flexible, durable, and lightweight.
Exceptionally easy to cut, install, connect, reuse, and relocate.
Sizes 1¼" thru 36" i.d.

Write for details today
Distributors in all principal cities

THE FLEXAUST COMPANY
Dept. HV-7
[illegible] PARK AVE. NEW YORK 17 N. Y.

Briefly Stated

is growing in popularity and acceptance, and that all indications are that it will gain still greater momentum in the future. Already more than half a million homes are electrically heated and estimates indicate that within 10 years this figure will have grown to more than three million, the company stated. . .

Stockholders of WARREN WEBSTER & Co., Camden, N. J., manufacturer of heating and cooling equipment, approved the sale of the business to Management & Development Corp., Baltimore, Md. The announcement came from Warren Webster, President of the 71 year old concern, who stated that the present Warren Webster & Company management will retain a substantial financial interest.

Mr. Webster explained that the new owners, headed by Herbert A. Wagner, president of Management & Development Corp., will be active in Warren Webster & Co. management and that he, himself, would continue to serve the company in an active capacity. He said that he foresaw very few changes in company operations or marketing policy, and that the name Warren Webster & Company would be retained by the new owners.

It was explained that Management & Development Corporation has been successfully engaged in industrial financing and management for a number of years. The company's plan is to concentrate on the expansion of Warren Webster & Company's facilities and product line. . .

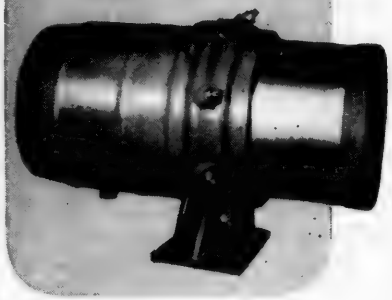
CLEAVER-BROOKS Co., Milwaukee, Wis., has concluded a working agreement with The Creamery Package Mfg. Co., Chicago, Ill., for the sale of the firm's Monitor package boilers to the dairy industry. The Creamery Package Mfg. Co. is a national manufacturing and sales organization selling process equipment, refrigeration and supplies to the dairy and food industries. . .

Construction of a new general office building in Chicago has been announced by JOSEPH T. RYERSON & SON., INC., warehousing subsidiary of Inland Steel Company. Located

important points about joints

- Yarway Gun-Pakt Joints are serviced *in the line under full steam pressure.*
- Costly shutdowns eliminated.
- Maintenance records show 1 manhour per year per joint.
- Fewer expansion joints needed per length of pipeline with Gun-Pakt.

YARWAY GUN-PAKT EXPANSION JOINTS



For new Yarway Expansion Joint Catalog EJ-1916 write YARNALL-WARING CO. 104 Mermaid Avenue, Phila. 18, Pa.

go YARWAY with confidence

adjacent to its plant at 16th and Rockwell Sts., it will be 210 by 210 ft, two stories, of steel frame construction with walls largely of glass and stainless steel. The building was designed by Skidmore, Owings & Merrill. General contractor is Sumner Sollitt Company. Completion is scheduled for late in 1960. . .

STANDARD STEEL CORP., Decatur, Ill., has concluded negotiations with CARRIER CORP., to acquire the assets of CAMBRIDGE CO., Lowell, it was announced. The latter company is now an operating division of Standard Steel. No purchase price was made public. Cambridge know-how in cryogenics is sought. . .

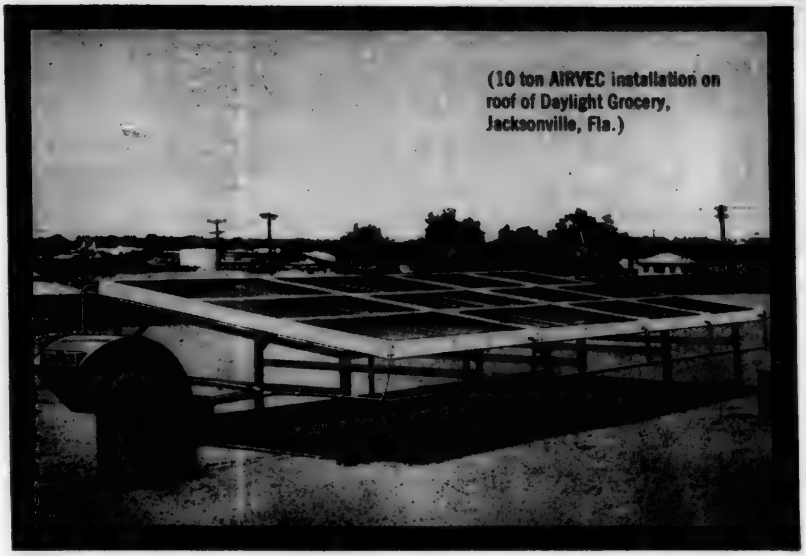
NEW REPRESENTATIVES

The Max-Arnold Company, 2227 North American Street, Philadelphia, Pa., is serving the plumbing trade for HARCRAFT BRASS, Torrance, Calif. The firm will act as Harcraft representatives for southern New Jersey and the east shore of Maryland, Delaware, and eastern Pennsylvania. Max-Arnold will offer a complete line of Harcraft products including centersets, diverters, swing spouts, faucets, flexible supplies, and shower rods. . .

A new representative for dual duct air mixing units has been appointed in Syracuse by BUENSOD-STACEY, INC., New York, N.Y. It is the Lewis Reid Company. . .

Appointment of five new sales representatives for MCQUAY, INC. heating and air conditioning products is announced. The five are: Campbell & Becker, Inc., 452 Broadway, Albany, N. Y.; The Bachman Co., 950 Cherokee, Denver; Lamb Engineering Co., 2125 Maryland Avenue, Baltimore; George Breitenbach, 519 Cynwyd Circle, Bala-Cynwyd (Philadelphia), Pa.; and Richard K. Peck, Jr., 3110 West Lambright Street, Tampa, Fla. . .

Southland Supply Company, Dallas, Tex., has been appointed a distributor of A. M. BYERS polyvinyl chloride (plastic) pipe. Already a distributor of Byers 4-D wrought iron pipe, Southland Supply will distribute PVC pipe throughout the Dallas area. W. M. Pattison Supply



(10 ton AIRVEC installation on roof of Daylight Grocery, Jacksonville, Fla.)

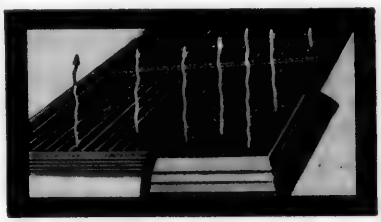
EDWARDS AIRVEC

...the air-cooled refrigerant condenser that eliminates fans, cooling towers, noise and maintenance.

For condensing refrigerants Edwards AIRVEC offers a simple, economical method that makes possible, for the first time, the elimination of fans, motors, and cooling towers! Because of its unique operating principle, AIRVEC requires no electrical power—the refrigeration or air conditioning system using AIRVEC requires 20% less power. With no moving parts there is no need for belts, pumps, fans or costly maintenance—and it's absolutely silent. And water is not used in the AIRVEC so there is no water treatment problem or periodic cleaning of condensers and towers.

The size of the condenser is virtually unlimited: you just assemble single AIRVEC elements in a single plane until the required area is covered. Initial installation costs are lower, too. And AIRVEC is so light that little or no special rigging is required.

Its low, unobtrusive silhouette blends easily with any architecture, leaving more useable space within the building proper. Roof loads are negligible so no extra beams are needed. Edwards AIRVEC Condensers are available in nominal sizes of 1.25, 2.50 and 3.75 tons and larger assembles up to hundreds of tons.



The refrigerant gas is cooled and condensed by the movement of convection air moving upward through the AIRVEC condenser.

Write today for comprehensive technical data.

EDWARDS ENGINEERING CORP.

1608-1 Alexander Avenue • Pompton Plains, New Jersey

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WORLD'S LARGEST MANUFACTURER OF WATER-COOLED CONDENSERS FOR PACKAGED EQUIPMENT.

WHY THERE'S NO "OR EQUAL" WHEN YOU SPECIFY WIREMOLD AIR DUCT

Unlike any other flexible air duct, Wiremold Air Duct is made with a *flat* metal spiral that *mechanically locks* to the fabric component. Here's what this construction means to you:

- With Wiremold you get a *mechanically locked* seam the same as you insist upon with sheet metal duct. There are no glues or adhesives that may dry out and fail with age.
- Wiremold's exclusive *flat* metal spiral assures accurate size — and snug connections.
- Cuffed ends (and cuffing equipment) are never needed.
- Unlike ducts with cuffed ends, Wiremold's fabric and metal are *both* secured to end fittings, making stronger connections.
- Two lengths of Wiremold can be joined simply by screwing them together. No collars or clamps are needed.

FOR AIR CONDITIONING • EXHAUSTING MATERIALS HANDLING • MANY OTHER USES

WIREMOLD® AIR DUCT

ask your distributor, or write
THE WIREMOLD COMPANY • HARTFORD 10, CONN.

Briefly Stated

Company, Cleveland, Ohio, has also been appointed a distributor. It will distribute PVC pipe throughout the Cleveland area. . .

James L. Brasher, 5400 Park Road, Charlotte, N.C., has been appointed sales representative for CORDLEY & HAYES, New York, N.Y., manufacturers of electric water dispensers, the firm announced. . .

AMERICAN AIR FILTER CO., INC., is taking steps to expand and strengthen its sales representation in the greater New York City area. Effective June 1, Associated Thermal Products, Inc., 534 West Broadway (New York City) increased its responsibilities to include all of AAF's air filter products (except intake air filters for engines and compressors) and Herman Nelson heating and ventilating products. Associated Thermal Products also represents AAF's Kennard Division air conditioning and air handling units. . .

W. D. ALLEN'S Manufactured Products Division announced the appointment of three new Midwest representatives as part of the company's program for expanding national distribution of their fire protection line. Stickler & Downs, Inc., Milwaukee, will represent the company in most of Wisconsin and the upper Michigan peninsula. A. C. Bjerken & Associates, St. Paul, Minn., was appointed representative for Minnesota, Iowa, North Dakota, South Dakota and part of Wisconsin. A. F. Becker, St. Louis, will cover the Missouri, Kansas, and Southern Illinois territory. . .

Zurn Systemettes, engineered behind-the-wall supporting systems for residential wall closet installations, will be sold nationally through a newly-created network of franchised representatives, it was revealed by ZURN INDUSTRIES, INC., Erie, Pa. Some 60 sales engineers,

(Concluded on page 132)

MORE STEAM-FASTER AT LOWER COST

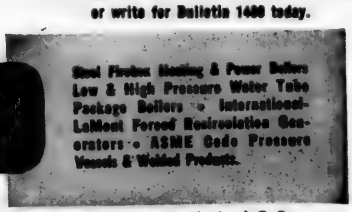
COMPAK water tube boilers are available as completely packaged forced draft units for low or high pressure service in 22 sizes from 12 to 750 HP.

Faster steaming is only one of the many superior features of INTERNATIONAL COMPAK WATER TUBE PACKAGE BOILERS.

No matter what you're looking for in a boiler — low cost . . . long life expectancy . . . high efficiency . . . low maintenance . . . easy cleaning . . . automatic, foolproof operation, etc. — it will pay you to take a closer look at the COMPAK.

Get full details from your INTERNATIONAL DISTRICT REPRESENTATIVE or write for Bulletin 1400 today.

IBW BOILER BUILDERS SINCE 1886


Steel Firebox Heating & Power Boilers
Low & High Pressure Water Tube Package Boilers
International-LaMont Forced Recirculation Generators
ASME Code Pressure Vessels & Welded Products

THE INTERNATIONAL BOILER WORKS CO.

890 Spruce St. East Stroudsburg, Pa.

Manufactured and sold in Canada under agreement with CANADIAN VICKERS LTD. Montreal, P. Q.

THE weil TVC

New *Condensate Pumps*

Features:
Low speed (1750 RPM) TVC pumps are easily installed in areas where space is important. Their compact cast iron receiver and sturdy pumping unit assure a trouble-free installation.

Dimensions:
26 gallon cast iron receiver for single or duplex units: Diameter 25"; height of return above floor 10½"; height of unit 36" max.

Installation:
Simple installation: one return connection, one discharge connection. Unit is completely assembled at the factory. Send for Bulletin TVC-300.

Send for Bulletin TVC-300

See Catalog in 1959 Sweet's and 1959 Domestic Eng. Cat. Dir.

Available from Jobbers Stocks!

TVC PUMPS now available in capacities from 750 to 15,000 sq. ft. E.D.R.

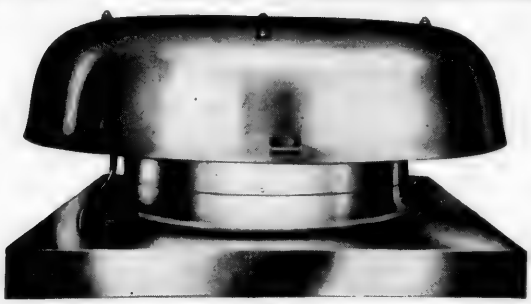
The three sizes of TVC receivers now offer a complete line of low pressure system condensate pumps to fit all requirements. The LOW RETURN CONNECTION and LOW SPEED — 1750 R.P.M., coupled with the built-in durability, operating efficiency and low cost of these pumps guarantee a satisfactory and trouble free installation. This pump provides gravity drainage for low heating units.

Specify and install a **weil** TVC Pump.

Built for ONE MILLION STARTS . . . without attention

1516 North Fremont Street • Chicago 22, Illinois

COOK Easy-to-install Aluminum ROOF VENTILATOR



Model QD—from 1200 to 38,350 CFM

Shipped completely assembled, with integral conduit to facilitate wiring. Direct drive fan has individually cast aluminum hub and blades. Blades are replaceable. Serviced from above the roof line. Extremely lightweight for size—38,350 cfm. unit weighs only 485 lbs. crated for shipping. Venturi type base and one-piece top cap are spun aluminum.

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2520 Helm Street
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Rochester 3, New York

Drico Industrial Corporation
100 Eighth Street
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Fram Corporation
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Minneapolis-Honeywell Regulator Co.
Minneapolis 8, Minnesota

Owens-Corning Fiberglas Corporation
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One Gateway Center
Pittsburgh 22, Pennsylvania

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***Technical Filter Co.**
2719 South Poplar Avenue
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Trion, Inc.
1000 Island Avenue
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Vortex Company
121 S. Alexander Avenue
Claremont, California

Westinghouse Electric Corporation
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Hyde Park, Boston 36, Massachusetts

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POWER BURNERS

Combination burners are available for the "OG-4," and are interchangeable with single fuel burners. All burners are of the same general construction; switching from dual fuel to a single fuel burner involves changing only one or two minor parts. On all burners the combustion air is pre-heated. "Push button" changeover from one fuel to another and electric gas ignition give added ease of operation and safety to the combination burners. Write today for the full story.

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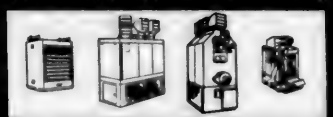

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Name_____

Company_____

Address_____ City_____

Title_____

Briefly Stated

(Concluded from page 130)

representing every major marketing area in the U.S. and Canada, received formal certificates of franchise from the company granting exclusive distribution rights in assigned areas.

WITH THE MANUFACTURERS

WALWORTH COMPANY, New York, N. Y. announced the appointment of new officers and board officials. The company's new president is the 38-year-old mechanical engineer, John C. Wallace. The appointment culminates the 2-year period he has been with Walworth, in which time he has held three vice-presidential positions. Vice-president and general sales manager is the 34-year-old engineer Harold Brown. Announcement has also been made of the ascension of Fred W. Belz, former Walworth president, to the position of chairman of the board. Mr. Belz has been with the company for 38 years. . . .

A. D. Rose was elected president of JAS. P. MARSH CORP., Skokie, Ill. He was formerly executive vice-president. Mr. Rose began his career with the company in 1918 working in what was then a small instrument and valve company. During the 1920's he organized the company's first Engineering and Development Department and his name appears on many patents granted during the ensuing years.

Edward F. Schweich, St. Louis, Mo., has been elected president of the LEWIN-MATHES COMPANY DIVISION OF CERRO DE PASCO CORPORATION. Mr. Schweich succeeds Richard H. Lewin, who last month was appointed vice president of Cerro de Pasco with responsibility for domestic nonferrous metal fabricating operations. Mr. Schweich's appointment as chief executive of Lewin-Mathes comes almost thirty years to the day from his first employment by the company on June 1, 1929. Throughout most of his association with Lewin-Mathes, he served as secretary of the company, and late last year was promoted to executive vice president.

WANTED

SALES MANAGER

For long established company located in east which manufactures industrial heating, ventilating and combustion equipment.

Company's sales normally in excess of $4,000,000 per year through manufacturers' representatives in United States and Canada. Company has progressive management and is well financed.

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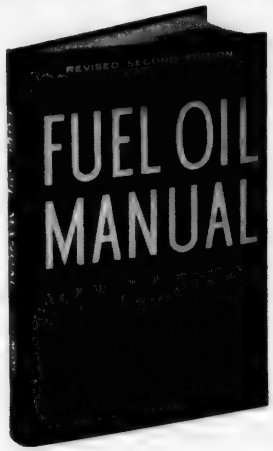
Prefer candidate between ages 35 and 48. Earnings of $20,000 plus per year, depending on man. Also possibility of title of Vice-president for Sales.

Interested candidates should send complete resume. Inclusion of small photo is welcome.

Our employees down through clerical level are informed of this opening and the Company's search for good candidates.

Reply to Box 944

Air Conditioning Heating and Ventilating
93 Worth St., New York 13, N. Y.



Here is a book that will give you a comprehensive picture of the characteristics and uses of every type and grade of fuel oil. The author explains the meaning of each oily property, and shows how this information is applied to the selection, handling and burning of fuel oil. Impurities and how they effect combustion are described fully, and a special chapter describes fuel oil additives and how they are used. Another chapter lists troubles which may be encountered in using fuel oils, and shows the correct remedy to apply in each case. Technical language is avoided wherever possible and all terms are fully explained.

168 Pages **$4.50** 34 Tables

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- Sticks instantly to anything.
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- *Write for free test sample.*

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NEW! EXTRUDED ALUMINUM SHUTTERS

Shutters of modern design which give you ALL of these features: Lightweight, Full Weather Strip, Low Freight Cost, Easier installation, Concealed Pivot Pins, Rust and corrosion Proof and Natural aluminum finish with fluted frames.

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So SIMPLE that "Specials" are Likely to be Standard!

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol

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LIQUID LEVEL CONTROL

Because of the utter simplicity of Magnetrol's magnetic operating principle, standard models can be easily adapted to meet any special requirements for pressure, temperature or corrosive liquids . . . and usually at little extra cost. This Magnetrol versatility has solved all kinds of tough level control problems . . . and given our engineers wide application experience that can be invaluable to you.

Magnetrol is so simple that failure is all but impossible! Using only permanent, unfailing magnetic force for its operation, there's nothing to wear out . . . no diaphragms or bellows to stiffen and rupture . . . no electrodes to short or corrode . . . no packing to bind or leak. Magnetrol is practically maintenance-free! Magnetrol units are available for controlling level changes from .0025-in. to 150-ft. . . . with multi-stage switching when desired. Send coupon for full details.

MAGNETROL, Inc. **Send Coupon For Full Details**

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Please send me catalog data and full information on Magnetrol Liquid Level Controls. 6

Name_____

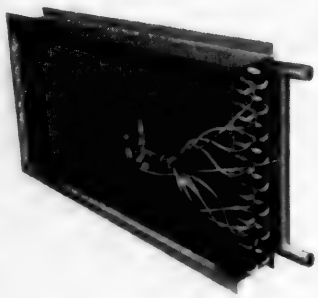
Company_____

Address_____

City_____ Zone_____ State_____

. . . another outstanding application of THERMAL Cooling and Heating Coils

Specifications for the cooling and heating coils in the main air conditioning system of the new ultra-modern *House of Tomorrow Musical Theater in Fort Worth called for not only top quality but **fast** delivery. Thermal Engineering delivered both.



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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

THERMODYNAMICS

For some unknown reason, there has been a large number of books published within the past year on Thermodynamics. Another volume has been added to this list, this time Thermodynamics by Gordon J. Van Wylen, chairman, department of mechanical engineering, University of Michigan. It is the result of supplementary notes prepared by the author for his students, and is designed to gives the student an appreciation and understanding of both the physical and the mathematical aspects of thermodynamics.

The first part of the book treats basic definitions and concepts, followed by an analysis of the first and second laws of thermodynamics. The first half of the text is rounded out with material involving the concepts of availability and irreversibility.

The second section of the book covers processes in reciprocating machinery and cycles. Also covered are flow through nozzles and blade passages, chemical reactions, combustion, equilibrium and thermodynamic properties.

Problems are presented at the end of each chapter, with numerical answers given at the back of the book.

Thermodynamics, by G. J. Van Wylen. Cloth bound, 6 x 9 inches, 567 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $7.95.

PIPE STRUCTURE ANALYSIS

The development of high pressure and high temperature piping systems has brought about greater appreciation of the need of pipe structures for stress and flexibility. Since serious hazards can accompany pipe failure, rule of thumb methods are no longer acceptable. To fill the need for basic information, Analysis of Pipe Structures for Flexibility was prepared by John Gascoyne, senior designer and stress consultant, Badger Manufacturing Co., Cambridge, Mass.

Chapters in this book cover methods of stress calculation; preliminary data and basic assumptions; an elastic-center method of stress calculation; translation of results; pipe supports, and worked examples for specific problems.

Analysis of Pipe Structures for Flexibility, by J. Gascoyne. Cloth bound, 7¼ x 9¾ inches, 180 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $7.50.

CONFERENCE ON AIR POLLUTION

A National Conference on Air Pollution was held in Washington, D. C., November 18 to 20, at which time a large number of valuable papers were presented by specialists in their respective fields. These papers varied from basic concepts of air pollution, health, economic

and social effects of air pollution to administrative aspects of air pollution.

Papers presented and the informal discussions of the three-day meeting are now available.

Proceedings, National Conference on Air Pollution. Publication of U. S. Department of Health, Education and Welfare. Paper bound, 6 x 9 inches, 526 pages. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, $1.75.

ASTM STANDARDS ON STEEL PIPING MATERIALS

This compilation of ASTM Standards on Steel Piping Materials contains all the specifications for carbon-steel and alloy-steel pipe and tubing issued by the American Society for Testing Materials. Specifications in this compilation cover: Pipe used to convey liquids, vapors and gases at normal and elevated temperatures; still tubes for refinery service: heat exchanger and condenser tubes, and boiler and superheater tubes. Also included are specifications for castings, forgings, weldings, bolts and nuts.

There are 71 standards in the book. Of these, 40 have recently been revised or have had their status changed within the year. This compilation replaces the edition published March, 1958. Many of the specifications in this compilation are incorporated in the ASME Boiler and Pressure Vessel Construction Code.

ASTM Specifications for Steel Piping Materials, published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Paper cover, 6 x 9 inches, 524 pages, $6.

AIR POLLUTION CONTROL

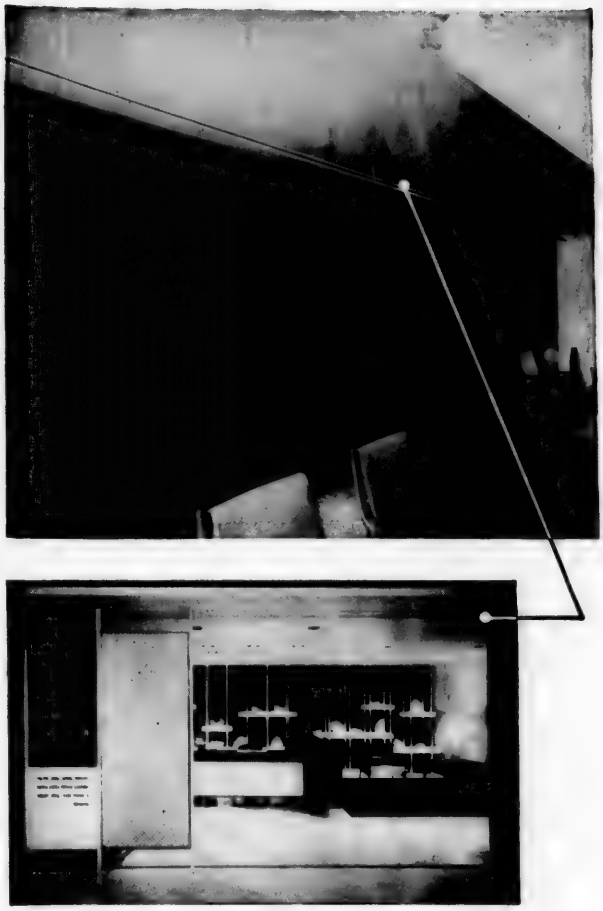
The basic facts that must be considered in any air pollution control program, are covered in Air Pollution Control, by W. L. Faith, managing director, Air Pollution Foundation. It is written so as to be understood by both the layman and the technical man who has not specialized in this subject.

Starting with an explanation of the effects of air pollution and the importance of meteorological variables, the text moves into a discussion of smoke, dusts, fumes, and mists, gases, odors, and automobile exhaust. It concludes with chapters on the making of an air pollution survey, and legal aspects. Extensive references are given at the end of each chapter.

Air Pollution Control by W. L. Faith. Cloth bound, 6 x 9 inches, 259 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $8.50.

• • •

GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS —The American Standards Association has approved the new edition of a code on Gas Transmission and Distribution Piping Systems. It includes many rulings of cases that have been made since 1955 when the first edition of this code was first published. This code is Section 8 of the American Standard Code for Pressure Piping and has been published by the American Society of Mechanical Engineers. Copies may be purchased from ASA, 70 E. 45th St., New York 17, N. Y., and ASME, 29 W. 39th St., New York 18, N. Y. Price, $2.50.



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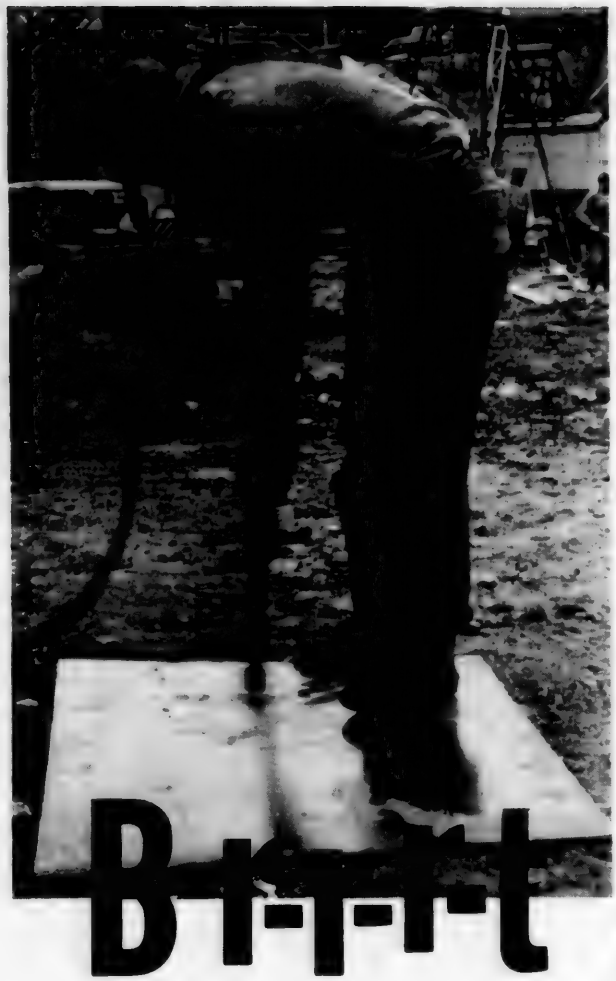

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Crumbling concrete is easy with this powerful paving breaker. It hits with crunching impact at the rate of 1,200 blows per minute with 75,000 ft. lbs. of developed energy. Yet, while thousands of repeated blows actually hammered this TI-CO galvanized sheet into the ground at the point of contact, there wasn't a trace of flaking of the zinc coating!

TI-CO won't flake or peel on the job, either. It's soft enough to take the most complicated forming, and when you hammer it flat it doesn't spring back—it stays flat!

TI-CO sheets take Pittsburgh lock-seaming or any other tough fabricating process without your worrying about make-overs. You get a good-looking, long-lasting installation . . . every time!

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INLAND TI-CO

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Canadian Degree-Days for May, 1959*

City	May		Cumulative	
	1959	Normal	1958-59	Normal
Calgary, Alta.	615	460	9258	8970
Charlottetown, P. E. I.	519	560	8734	8330
Crescent Valley, B. C.	488	400	7737	7610
Edmonton, Alta.	537	410	9661	9830
Fort William, Ont.	509	540	10351	10180
Grande Prairie, Alta.	532	460	10668	10390
Halifax, N. S.	474	484	7474	7246
London, Ont.	264	330	7524	7230
Medicine Hat, Alta.	473	320	8728	8450
Moncton, N. B.	425	480	8866	8500
Montreal, P. Q.	227	270	8359	8240
North Bay, Ont.	385	470	9676	9520
Ottawa, Ont.	264	330	8762	8580
Penticton, B. C.	361	260	6393	6270
Prince George, B. C.	534	480	9068	8980
Quebec City, P. Q.	312	430	9598	9240
Regina, Sask.	484	420	10377	10400
St. John, N. B.	460	510	8695	8380
Saskatoon, Sask.	471	420	10458	10610
Timmins, Ont.	454	550	10770	11060
Toronto, Ont.	257	316	7035	6898
Vancouver, B. C.	352	320	5159	5230
Victoria, B. C.	395	350	5017	4870
Windsor, Ont.	211	270	6896	6560
Winnipeg, Man.	491	411	10794	10399

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

WHAT READERS SAY

Kitchen Ventilation—A Rebuttal

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING

In the June issue of AIR CONDITIONING, HEATING AND VENTILATING, M. E. Price commented on the article I prepared on Commercial Kitchen Ventilation. I wish to make clear that there was certainly no intention on my part to imply that it is impractical to air condition commercial kitchens. The rule-of-thumb formulas which I recommended be used for sizing kitchen exhasut systems are minimum ones for proper exhaust systems and are used or recommended by almost all reputable authorities, including the National Fire Protection Association and the National Board of Fire Underwriters.

I agree that the resulting air volumes are large but, unfortunately, these are necessary in order to catch and effectively remove grease-laden cooking vapors and odors. As pointed out in the article, the amount of heat input to the appliances has no bearing whatever on the exhaust system design since the high air velocities and resultant high air volumes are necessary for removal of the heavier cooking vapors.

It should also be noted that since the exhaust system sizing methods are rule-of-thumb, their application to unusual situations requires interpretation by someone experienced in the design of air conditioning and ventilating systems.

The example used by Mr. Price in his illustration is unusual since it consisted of a very large 40 ft x 60 ft kitchen, and a relatively small number of cooking appliances (only 100 kw connected load). In addition, Mr. Price assumed an institutional kitchen which had no adjacent dining area. Where a dining area is present, all of the ventilation air, based on 15 cfm per person, could be ex-

hausted through the kitchen and its exhaust system, thereby substantially reducing the amount of replacement air which must be supplied to the kitchen from outdoors. This latter and more typical installation greatly reduces the refrigeration load needed to condition the make-up air.

Experienced designers might find many ways to air condition the kitchen cited by Mr. Price without supplying 43 tons of refrigeration to condition the replacement air. Actually, the hood design in such an unusual type of kitchen could probably be based on the face velocity method cited in the article, and not on the air change method. This, again, illustrates where experienced judgment must be used in unusual circumstances in order to properly apply the basic fundamentals discussed in the article.

Edgar A. Jahn
Assistant Director
Utilization Bureau

American Gas Association,
New York, N. Y.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

ASSE MEETING—Annual meeting of The American Society of Sanitary Engineering, at the Mayflower Hotel, Washington, D. C. M. Mercury, treasurer-secretary of the Society, 4328 South Western Ave., Chicago 9, Ill. ..... **JULY 19-24, 1959.**

HEAT TRANSFER CONFERENCE—Sponsored by American Society of Mechanical Engineers and American Institute of Chemical Engineers, Heat Transfer Conference, University of Connecticut, Storrs, Conn. ASME Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **AUGUST 9-12, 1959.**

CRYOGENIC ENGINEERING CONFERENCE—1959 Cryogenic Engineering Conference to be held at the University of California, Berkeley, Calif. K. D. Timmerhaus, secretary of the Conference, Chemical Engineering Dep't., University of Colorado, Boulder, Colo. ..... **SEPTEMBER 2-4, 1959.**

INDUSTRIAL GAS SCHOOL—Industrial gas school of the American Gas Association, Penn-Sheraton Hotel, Pittsburgh, Pa. Ralbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **SEPTEMBER 14-18, 1959.**

MANAGEMENT CONFERENCE—Engineering management conference sponsored by ASME and AIEE at the Statler-Hilton Hotel, Los Angeles, Calif. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 17-18, 1959.**

PETROLEUM CONFERENCE—Petroleum Mechanical Engineering Conference at Rice Hotel, Houston, Tex. ASME secretary, O. B. Schier II, 29 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 20-23, 1959.**

ISA INSTRUMENT-AUTOMATION EXHIBIT—14th annual Instrument-Automation Conference and Exhibit of the Instrument Society of America, at the International Amphitheatre, Chicago, Ill. H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. ..... **SEPTEMBER 21-25, 1959.**

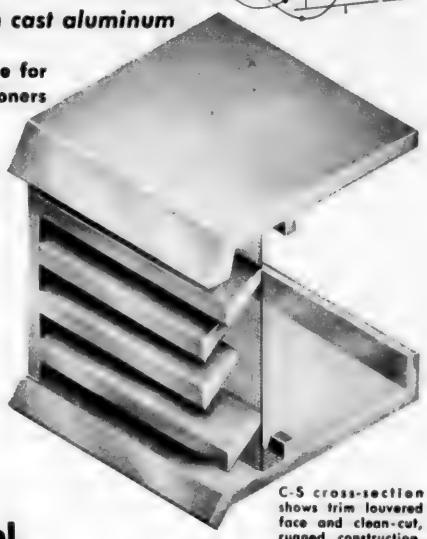
WELDING SOCIETY MEETING—Fall meeting of the American Welding Society, at the Sheraton-Cadillac Hotel, Detroit, Mich. A. L. Phillips, American Welding Society, 33 W. 39th St., New York 18, N. Y. ..... **SEPTEMBER 28-OCTOBER 1, 1959.**

(Concluded on page 138)

C/S ventilating BRICKS and BLOCKS

in cast aluminum

ideal air intake for unit air conditioners



C-S cross-section shows trim louvered face and clean-cut, rugged construction, with integral cast water-stop and snugly fit screening.

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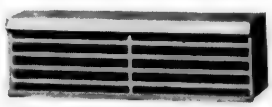
high air intake efficiency

When you design your next air conditioning or ventilating project—be sure to consider the benefits you can get using C-S vent bricks or blocks. You can be sure they will cost less to buy. What's more, they cost less to install because their dimensions are the same as those of standard or jumbo brick, or block. Twelve modular sizes are available for standard brick construction, two for jumbo brick, and three for cinder or concrete block construction—to go in as the wall goes up.

Another thing: C-S vent bricks and blocks are certified tested, comply with F.H.A. requirements—and give complete customer satisfaction. They cannot rust, corrode, or stain adjacent walls. They are durable—rugged—good looking and are available in a variety of finishes to meet job requirements.



representatives in all principal cities
—same day shipment

model 4-B—representative of 13 modular brick and block sizes available—is equal to four standard bricks, measures 16½" x 4⅞" x 4" and has a high free area.

Write today for 1959 C-S catalog and price and specification data.

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Please send me the new 1959 C-S brick size vent catalog and complete price and delivery data.

Name_____

Firm_____ Title_____

Address_____

(Concluded from page 137)

REFRIGERATION SERVICE ENGINEERS CONVENTION—Convention of the Refrigeration Service Engineers Society, at the Ambassador Hotel, Atlantic City, N. J. Secretary of the Society, 433 No. Waller Ave., Chicago, Ill. ..... **OCTOBER 30-NOVEMBER 2, 1959.**

AGA CONVENTION—Annual convention of the American Gas Association, at the Conrad-Hilton Hotel, Chicago, Ill. C. S. Stackpole, managing director of the Association, 420 Lexington Ave., New York 17, N. Y. ..... **OCTOBER 5-7, 1959.**

ASA CONFERENCE—10th National conference on Standards, at the Sheraton-Cadillac Hotel, Detroit, Mich. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. ..... **OCTOBER 20-22, 1959.**

ARI EXPOSITION—11th Exposition of the Air-Conditioning and Refrigeration Industry at Convention Hall, Atlantic City, N. J. Geo. S. Jones, Jr., managing director of Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C. ..... **NOVEMBER 2-5, 1959.**

METAL EXPOSITION & CONGRESS—41st National Metal Exposition & Congress, sponsored by the American Society for Metals, at the International Amphitheatre, Chicago, Ill. Seward Covert & Associates, 1059 Leader Bldg., Cleveland 14, Ohio. ..... **NOVEMBER 2-6, 1959.**

HOTEL EXPOSITION—National Hotel Exposition, New York Coliseum, New York, N. Y. ..... **NOVEMBER 2-6, 1959.**

CONTROL CONFERENCE—National Automatic Control Conference, sponsored by ASME, IRE, AIEE, ISA, Sheraton Hotel, Dallas, Tex. ASME Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 4-6, 1959.**

CEC SEMI-ANNUAL MEETING—Consulting Engineers Council, Board of Directors semi-annual meeting, Cincinnati, Ohio (hotel to be selected). Executive Secretary, L. N. Spiller, 326 Reisch Building, Springfield, Ill. ..... **NOVEMBER 4-7, 1959.**

COMMERCIAL KITCHEN PLANNING—Seminar on commercial kitchen planning at Michigan State University, East Lansing, Mich. Ralbern H. Murray, American Gas Association, 420 Lexington Ave., New York 17, N. Y. ..... **NOVEMBER 9-13, 1959.**

ASME ANNUAL MEETING—Annual meeting of the American Society of Mechanical Engineers, Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, O. B. Schier, II, 29 W. 39th St., New York 18, N. Y. ..... **NOVEMBER 29-DECEMBER 4, 1959.**

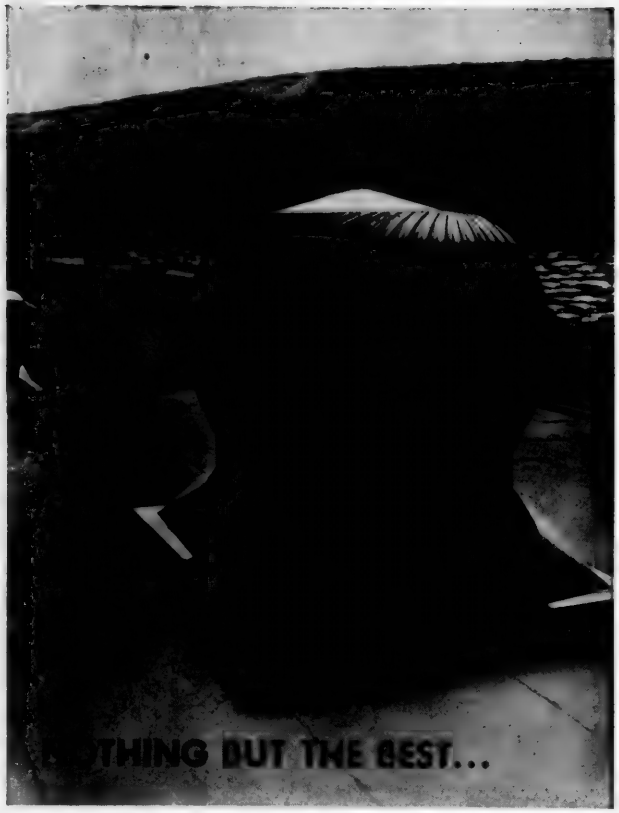
WARM AIR HEATING CONVENTION—Annual convention of the National Warm Air Heating and Air Conditioning Association, at the Chase Hotel, St. Louis, Mo. G. Boeddener, managing director of the Association, 640 Engineers Bldg., Cleveland 14, Ohio. ..... **DECEMBER 1-4, 1959.**

ASHRAE MEETING—Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and the 2nd Southwest Heating and Air-Conditioning Exposition, sponsored by ASHRAE, in Dallas, Tex. The meeting will be at the Baker and Adolphus Hotels, and the Exposition in the Memorial Auditorium. Secretary of the Society, 62 Worth St., New York 13, N. Y. ..... **FEBRUARY 1-4, 1960.**

GAMA MEETING—Annual Meeting of the Gas Appliance Manufacturers Association, at The Greenbrier, White Sulphur Springs, West Va. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. ..... **MARCH 30-APRIL 1, 1960.**

WELDING SOCIETY MEETING—41st annual Meeting and Welding Exposition of the American Welding Society in Los Angeles, Calif. Headquarters to be announced later. A. L. Phillips, secretary of the Society, 33 W. 39th St., New York 18, N. Y. ..... **APRIL 25-29, 1960.**

CONGRESS ON OCCUPATIONAL HEALTH—13th International Congress on Occupational Health, first to be held in the Western Hemisphere, at the Waldorf Astoria Hotel, New York City. Dr. Leo Wade, organizing committee, 15 W. 51st St., New York 19, N. Y. ..... **JULY 25-29, 1960.**



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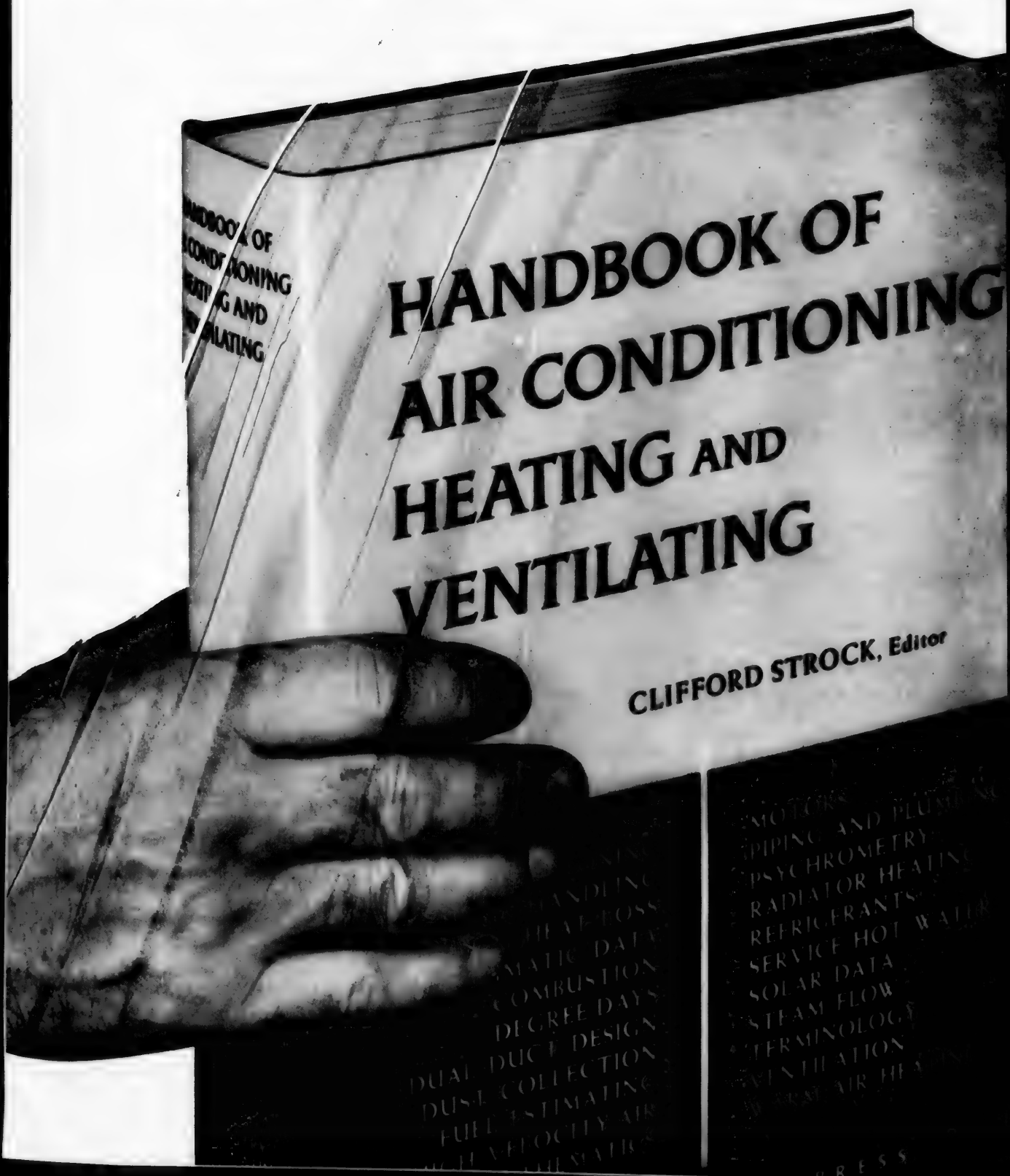

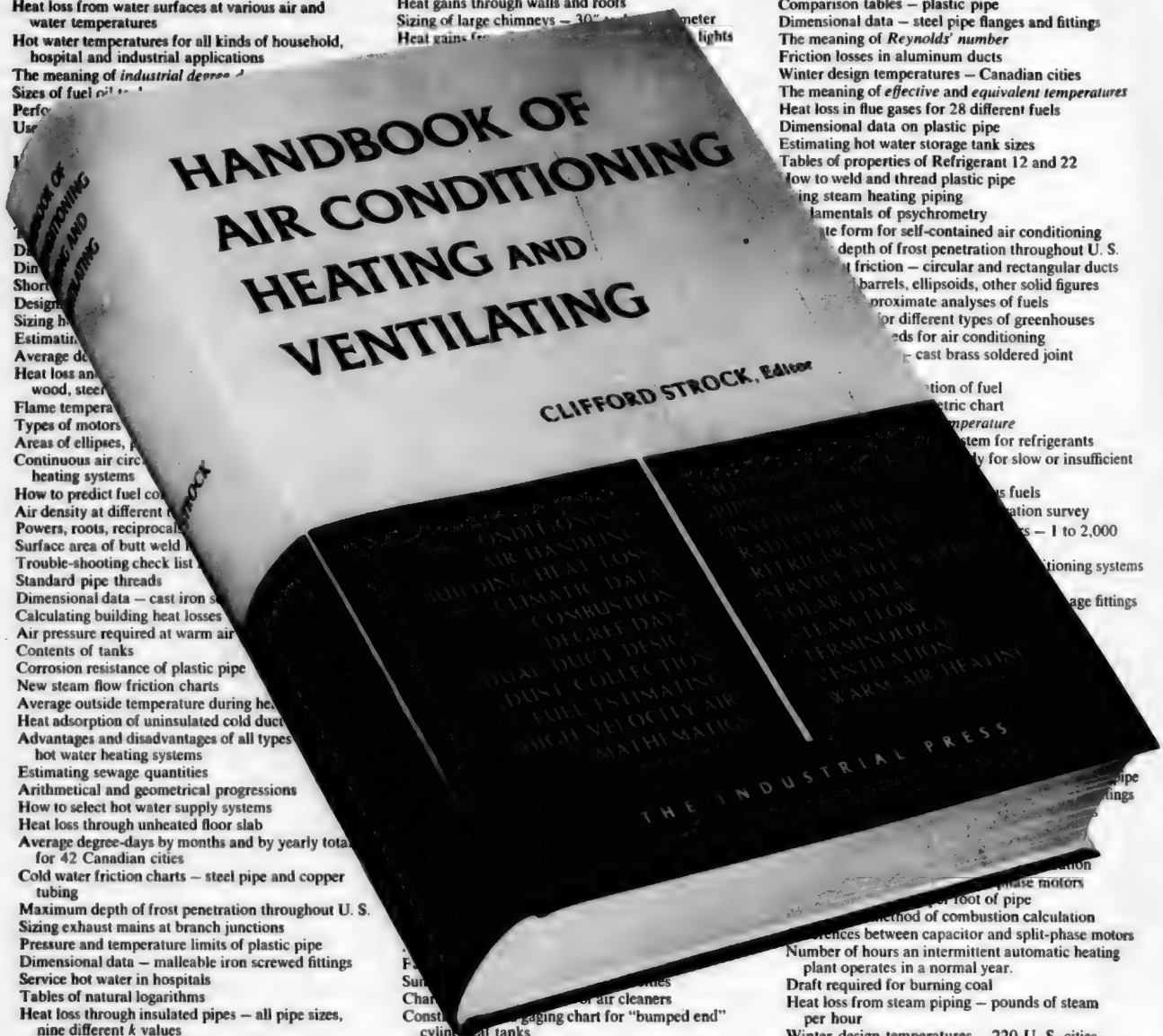

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Heat loss an wood, steel
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Types of motors
Areas of ellipses,
Continuous air circ heating systems
How to predict fuel co
Air density at different
Powers, roots, reciprocals
Surface area of butt weld
Trouble-shooting check list
Standard pipe threads
Dimensional data – cast iron s
Calculating building heat losses
Air pressure required at warm air
Contents of tanks
Corrosion resistance of plastic pipe
New steam flow friction charts
Average outside temperature during he
Heat adsorption of uninsulated cold duct
Advantages and disadvantages of all types hot water heating systems
Estimating sewage quantities
Arithmetical and geometrical progressions
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Heat loss through unheated floor slab
Average degree-days by months and by yearly total for 42 Canadian cities
Cold water friction charts – steel pipe and copper tubing
Maximum depth of frost penetration throughout U. S.
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Dimensional data – malleable iron screwed fittings
Service hot water in hospitals
Tables of natural logarithms
Heat loss through insulated pipes – all pipe sizes, nine different *k* values
Calculating heat transfer by air by convection
Threshold, or maximum allowable limits of toxic gases and fluids
Frequency of occurrence of low temperatures in 120 U. S. cities
Conversion factors
Dimensional data – cast iron screwed fittings
Material for ducts handling corrosive gases
Average annual snowfall throughout U. S.
Amount of ventilation air required
Demand on cold water piping systems and fixtures
Register temperatures in warm air heating
Type of bearings for a motor used for a belt drive
Performance and application data – axial flow fans
Dimensional data – brass and bronze flanged fittings
The meaning of *adsorption*
Best type of motor to use for a hot water pump
Heat loss from copper tubing
High temperature psychrometric chart to 1500 deg
Step-by-step procedure in duct design
Cooling degree-days – a degree-day unit for estimating summer air conditioning needs
Equivalent resistance of valves and fittings in terms of lengths of straight pipe
Required air volume in a heating or cooling system
Psychrometric chart applicable to barometric pressures to 8,000 ft. above from 8,000 ft. below sea level
Short-cut preliminary cooling estimates
How to use a slide rule
Surface area of flanged fittings
How to test exhaust ventilating systems
Effect of enclosures on radiator heat transmission
The meaning of *Clo* and *Met*
Heat gains through walls and roofs
Sizing of large chimneys – 30" meter
Heat gains fr lights
Su
Cha or air cleaners
Const gaging chart for "bumped end" cylin eal tanks
Dimensional data – cast brass soldered joint fittings
Heating of fuel oil
Trigonometric functions
How to analyze flue gases
Viscosity of liquids at various temperatures
Attainable CO_2 – all types of fuels
Procedure for preparing plumbing drawings
Summer dry- and wet-bulb temperatures for 230 cities
Estimate form for room air conditioning
Centrifugal pump selection
Dimensional data – fittings for refrigerant piping
Areas of segments of circles
Chemistry of combustion
The meaning of *apparatus dew point*
Graphs for spacing pipe hangers
Operating characteristics of centrifugal pumps
Volume flow in pipes and tubes
The meaning of *isopsychric*
Laying lengths of pipe with screwed fittings
Layouts and hook-ups of fuel oil storage tanks
Corrosion resistance of all kinds of metal pipe
Noise level of warm air grilles
Dimensional data – cast iron flanges and fittings
Heat loss through all types of standard doors
Gas piping in buildings – residential, commercial, industrial
Weight of metal in rectangular ducts
Difference between relative, absolute, percentage and specific humidity
Weight of air required for perfect combustion
Heat emission from animals
Angles of sliding for various coals
Capacities of chimneys for gas-burning equipment
Comparison tables – plastic pipe
Dimensional data – steel pipe flanges and fittings
The meaning of *Reynolds' number*
Friction losses in aluminum ducts
Winter design temperatures – Canadian cities
The meaning of *effective* and *equivalent temperatures*
Heat loss in flue gases for 28 different fuels
Dimensional data on plastic pipe
Estimating hot water storage tank sizes
Tables of properties of Refrigerant 12 and 22
low to weld and thread plastic pipe
ing steam heating piping
lamentals of psychrometry
te form for self-contained air conditioning
depth of frost penetration throughout U. S.
t friction – circular and rectangular ducts
barrels, ellipsoids, other solid figures
proximate analyses of fuels
or different types of greenhouses
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tion of fuel
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stem for refrigerants
ly for slow or insufficient
s fuels
ation survey
s – 1 to 2,000
itioning systems
age fittings
pipe
tings
tion
phase motors
foot of pipe
ethod of combustion calculation
rences between capacitor and split-phase motors
Number of hours an intermittent automatic heating plant operates in a normal year.
Draft required for burning coal
Heat loss from steam piping – pounds of steam per hour
Winter design temperatures – 220 U. S. cities
Friction losses in duct elbows and fittings
Cold water requirements for homes, buildings, theaters, restaurants, etc.
Solutions of equations
Heat loss through heated floor slabs
The meaning of *eupatheoscope*
Air conditioning equipment maintenance schedule
Mixing of hot and cold water
Maximum attainable draft per foot of chimney
Ignition temperature of fuels
Radiation from warm surfaces to cold ones
Color codes for pipe lines
The meaning of *pH*
Standard drafting room symbols for air conditioning, heating, ventilating, valves, piping and plumbing
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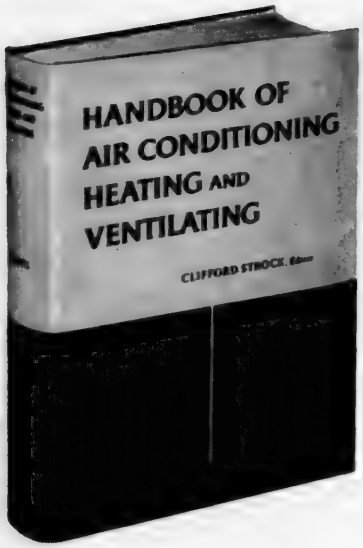

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Thermometric Scales and Conversions . . . Heat Transfer by Radiation . . . Heat Loss from Water Surface . . . Heat Transfer by Convection . . . Climatic Data and Maps . . . Winter Design Temperatures . . . The Degree-Day . . . Heating Design Maps . . . Industrial Degree-Days . . . Calculating Building Heat Losses . . . Heat Lost by Infiltration . . . Heat Loss from Floor Slabs . . . Heat Loss through Windows . . . Short Cut Heat Loss Estimating . . . Window Condensation . . . Steam and Hot Water Systems . . . Boiler Ratings . . . Greenhouse Heating . . . Heat Losses from Pipe . . . Hot Water Temperatures and Requirements . . . Hot Water Supply Systems . . . Flash Steam Calculations . . . Warm Air Heating . . . Heating System Servicing . . .

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ALPHABETICAL INDEX OF ADVERTISERS

A

Aerofin Corp. ..... *
Aerovent Fan Co., Inc. 146
Air Conditioning & Refrigeration Institute ..... *
Air Devices, Inc. 42, 135
Air Filter Corp. 125
Air Filter Institute 131
Air-Maze Corp. ..... *
Airtemp Div., Chrysler Corp. 31
Alco Valve Co. 119
Allen-Bradley Co. ..... *
Allen Cooler & Ventilator, Inc. ..... *
Allen, W. D., Mfg. Co. 12-13
Allied Chemical Corp., General Chemical Div. 5
American Brass Co. 11
American Gas Association 24-25
American Machine and Metals, Inc. .. *
American-Standard Industrial Div. .. 20-21
Ammerman Co., Inc. ..... *
Anemostat Corp. of America 39
Armstrong Machine Works 1
Arno Adhesive Tapes, Inc. 133

B

Babbitt Steam Specialty Co. 145
Barber-Colman Co. 103
Bell & Gossett Co. 111
Bethlehem Steel Co. 107
Binks Manufacturing Co. ..... *
Bridgeport Brass Co. ..... *
Bryan Steam Corp. 127
Buensod-Stacey, Inc. ..... *
Buffalo Forge Co. 19
Buffalo Pumps Div., Buffalo Forge Co. 27
Burt Manufacturing Co. ..... *
Byers, A. M., Co. 9

C

Cain Manufacturing Co., Inc. 124
Carrier Corp. 28-29
Chicago Pump Co. 122
Clarage Fan Co. 34
Classified Advertisements 143
Cleaver-Brooks Co., Boiler Div. ..... *
Concrete Thermal Casings, Inc. 126
Construction Specialties, Inc. 137
Cook, Loren, Co. 131
Cordley & Hayes 104
Coyne & Delany Co. 7

D

Davis Engineering Corp. 35
DeBothezat Fans Div., American Machine and Metals, Inc. ..... *
Dravo Corp. 109
Drayer-Hanson Div., National-U. S. Radiator Corp. 106
Dunham-Bush, Inc. 2
Dwyer, F. W., Manufacturing Co. ... *

(Continued on page 144)

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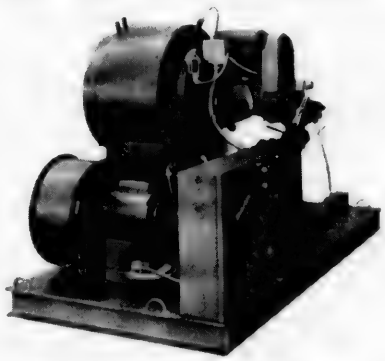

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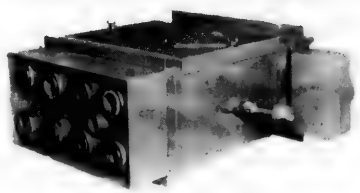

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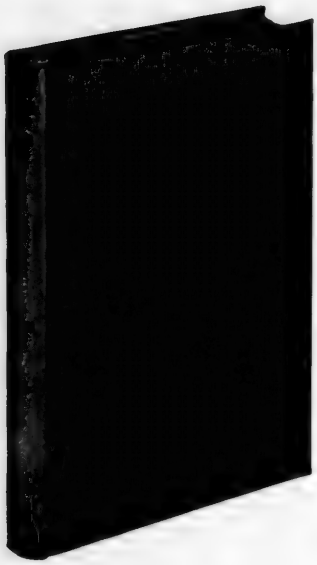

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ALPHABETICAL INDEX OF ADVERTISERS

(Continued from page 143)

E

Edwards Engineering Corp. 129
Elgo Shutter & Mfg. Co. 133
Emerson Electric Mfg. Co. ..... *

F

F5 Air Conditioning Corp. ..... *
Fafnir Bearing Co. ..... *
Flexaust Co. 128
Frick Company 36

G

Governair Corp. ..... *
Greenheck Fan & Ventilator Corp. .. *
Gustin-Bacon Manufacturing Co. 43

H

Halstead & Mitchell 23
Harris, Arthur & Co. ..... *
Hartzell Propeller Fan Co. ..... *
Henry Valve Co. .....Inside Back Cover
Hoffman Specialty Manufacturing Corp. ..... *
Hydrotherm, Inc. ..... *

I

Ilg Electric Ventilating Co. ..... *
Illinois Testing Laboratories, Inc. 108
Industrial Press 123, 139-142
Inland Steel Co. 136
International Boiler Works Co. 130
Iron Fireman Manufacturing Co. .... *

J

Jenkins Bros. 121
Jenn-Air Products Co., Inc. ..... *
Johns-Manville ..... *
Johnson Service Co. 33
Joy Manufacturing Co. ..... *

K

Kaiser, E. B., Co. ..... *

L

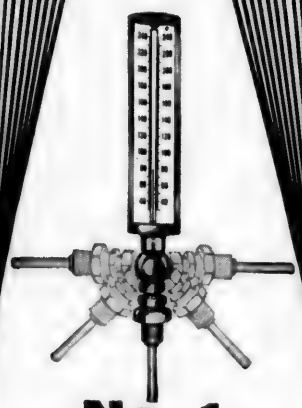
Lawler Automatic Controls, Inc. 38
Lennox Industries, Inc. 132

M

Magnetrol, Inc. 133
Marsh Heating Equipment Co. 26
McDonnell & Miller, Inc. .....Back Cover
McQuay, Inc. 117
Minneapolis-Honeywell Regulator Co. .....Insert 17-18

N

Nash Engineering Co. 44
National Tube Div., United States Steel Corp. ..... *
New York Blower Co. 15
Niagara Blower Co. ..... *
Nibco, Inc. ..... *



No. 1 SPACE STRETCHER

"Inner space" problems are sometimes more baffling to engineers, architects and contractors than those concerned with "outer space."

That needed inch or two amid the usual maze of pipe, conduit, tube and cable is worth its size in gold!

Where space is a factor, that's the place for Weksler ADJUST-ANGLE* Thermometers. These versatile instruments, supplied in four case sizes, meet every installation requirement. The exclusive Weksler ADJUST-ANGLE feature permits positioning of stem or case to fit any space.

MORE THAN A HUNDRED THOUSAND ADJUST-ANGLE INSTALLATIONS!

Write for complete information.

*PATENTED

WEKSLER INSTRUMENTS

WEKSLER INSTRUMENTS CORP.
FREEPORT, L. I., NEW YORK
INDICATING AND RECORDING INSTRUMENTS FOR TEMPERATURE, PRESSURE AND HUMIDITY

ALPHABETICAL INDEX OF ADVERTISERS

P

Patterson-Kelley Co. ..... *
Peerless Electric Co. 32
Petro 37
Pittsburgh Plate Glass Co. ..... *
Powers Regulator Co. 113
Pyle-National Co. 22

Q

Quickdraft Corp. 110

R

Reading Tube Corp. ..... *
Research Products Corp. 40
Revere Copper & Brass, Inc. ..... *
Reznor Manufacturing Co. ..... *
Ric-Wil, Inc. ..... *

S

Sarco Co., Inc. ..... *
Sarcotherm Controls, Inc. ..... *
Skidmore Corp. 115
Smith, Jay, R., Mfg. Co. 146
Spence Engineering Co., Inc. ..... *
Sporlan Valve Co. ..... *
Spraying Systems Co. ..... *
Sturtevant Div., Westinghouse Electric Corp. ..... Inside Front Cover
Symmons Engineering Co. ..... *

T

Thermal Engineering Corp. 134
Trane Co. ..... *

U

United States Steel Corp., National Tube Div. ..... *

V

Vilter Manufacturing Co. ..... *

W

Wagner Electric Corp. 41
Waterloo Register Co., Inc. 105
Watts Regulator Co. ..... *
Webster Electric Co. 125
Webster Engineering Co. 143
Weil-McLain Co. 30
Weil Pump Co. 131
Weirton Steel Co., Div., National Steel Corp. ..... *
Weksler Instruments Corp. 145
Western Engrg. & Mfg. Co. 138
Westinghouse Electric Corp., Sturtevant Div. ..... Inside Front Cover
Wheeling Steel Corp. ..... *
Wiremold Co. 130

Y

Yarnall-Waring Co. 128

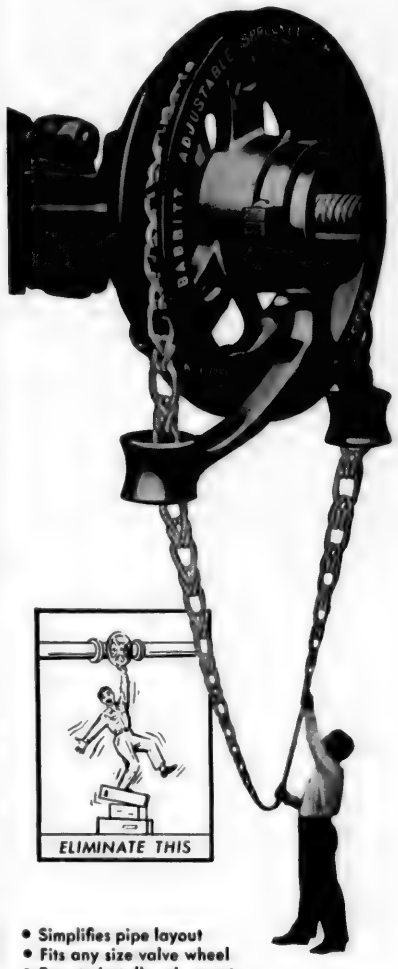
* Advertiser appeared in preceding issue

SAFE OPERATION OF OVERHEAD VALVES

with a

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide



- Simplifies pipe layout
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost *only* cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

5 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

increase production capacity ...
improve fan and heating efficiency

gas-fired air make-up units

Pictured above is a portion of the final assembly line at Aerovent showing 8 units slated for delivery to a large Midwestern automobile accessory manufacturing plant. Designed to supply ample quantities of clean, pre-heated or cool, outside air to replace air exhausted by ventilating systems, the Aerovent Gas-Fired Air Make-Up Unit keeps air fresh; eliminates drafts and negative pressures. Safe, dependable operation and automatic, semi-automatic or manual control with natural, mixed, manufactured or propane gas.

For winter or summer use, these compact, packaged units are available in four unit arrangements and four sizes from 36" to 54" for various capacities, BTU ratings and pressure conditions.

Write for bulletin 880.

OTHER UNITS AVAILABLE FOR STEAM OR HOT WATER

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent

FAN COMPANY, INC.

Ash and Brandt Streets — Piqua, Ohio

SMITH® HYDRO-trol

HYDROSTATIC SHOCK CONTROL

CONTROLS HYDROSTATIC SHOCK

CONTROLS PRESSURE WITH PRESSURE

STOPS PIPING KNOCK

Hydro-Trol's Pressurized Design using Pneumatic and Hydraulic Pressure to control Hydrostatic Pressure . . . provides a more effective and efficient way to control Hydrostatic Shock and eliminate water hammer in any hot or cold water piping system.

PRESSURIZED DESIGN

NITROGEN PRESSURIZED COMPRESSION CHAMBER
Controls bellows expansion under normal water line pressure so that full expansion capacity is available to control shock.

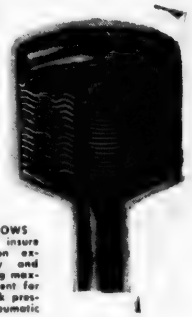
HYDRAULIC FLUID

STAINLESS STEEL BELLOWS

IN LINE DESIGN
Direct Action Type Bellows respond instantly to control shock pressures.

PNEUMATIC PRESSURE
As shock occurs, bellows expand creating a pneumatic pressure cushion which absorbs and controls shock.

HYDRAULIC PRESSURE
Controls bellows alignment and cushions bellows contraction to control shock wave bounce.



BALANCED BELLOWS
Constructed to insure each convolution expanding evenly and equally providing maximum displacement for dissipating shock pressures into pneumatic cushion.

Built to withstand and control the extreme pressures of Hydrostatic Shock, the bellows are pneumatically and hydraulically controlled and cushioned against metal to metal contact, shock, stress, or strain . . . ever causing metal fatigue and bellows failure.

Using no rubber or synthetic compressables, Hydro-Trol's all stainless steel internal construction is unaffected by temperatures and time. Factory sealed, and permanently pressurized, Hydro-Trol more efficiently and effectively controls Hydrostatic Shock and may be counted upon to last the "Life of the Piping System."

SIX SIZES
Meets the requirements of every hot or cold water distribution system.

COMPACT IN SIZE
Installs in small pipe chase spaces.

LIGHTER IN WEIGHT
Requires no supporting devices.

SIMPLIFIED SIZING
Hydro-Trol makes sizing simple and easy.

JAY R. SMITH MFG. CO.
Union, New Jersey
PLUMB-EASY

FOR FURTHER INFORMATION WRITE FOR YOUR COPY OF "SHOCK CONTOL BY HYDRO-TROL"

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

ELECTRONIC AIR CLEANING .....
is accomplished completely automatically with Westinghouse units. One merely pushes a button or sets a clock, then the self-contained unit maintains top cleaning efficiency without manual attention. Efficiencies up to 97%. Air velocities up to 600 fpm. Air capacities from 1920 to 28,800 cfm. Information available.
Inside Front Cover — Item 200

STEAM TRAPS FOR HEATING .....
by Armstrong Machine Works are discussed in O.F.&T. trap bulletin which explains how they work and why they should be specified. Unit heater bulletin also offered.
Page 1 — Item 201

HOSPITAL CONDITIONING .....
can be accomplished with a complete outdoor Dunham-Bush installation. System can be installed during a normal working day with practically no loss of operating time. Data on company's contributions to better hospitals available.
Page 2 — Item 202

REFRIGERANT CYLINDER CARRIER ...
doubles as a charging stand. It is offered during July and August with the purchase of 22 lb or more of Genetron refrigerants. Information is available.
Page 5 — Item 203

UNIQUE IN FLUSH VALVES .....
is Coyne & Delany, who offers the only completely diaphragm-operated line of nationally distributed flush valves. All are of premium quality. All will last the life of the building. Your inquiries are invited.
Page 7 — Item 204

WROUGHT IRON PIPE .....
for snow melting and radiant heating systems, is produced by A. M. Byers Co. Increased corrosion resistance and improved mechanical and physical properties make it ideal for these purposes. Also, has identical coefficient of expansion as that of concrete. Literature available.
Page 9 — Item 205

ALL-COPPER PLUMBING .....
supplied by The American Brass Co. was installed in Gower School addition, Hinsdale, Ill., at lower cost to taxpayers. Contractors found that installation economies with Anaconda copper tube and solder-joint fittings enables them to offer all-copper plumbing at a cost lower than competitive bids based on ferrous types. Information available.
Page 11 — Item 206

FREE CHECK BOOK .....
available from Allenco, gives basic fire protection requirements. A handy reference in selection and installation of equipment. Shows basic requirements for: Standpipe system, hose stations, extinguishers, exterior centers.
Pages 12-13 — Item 207

BELTED ROOF VENTILATOR .....
is propeller-type unit manufactured by New York Blower. Galvanized construction. Quality details. Bulletin discusses units in capacities from 4450 to 33,900 cfm, and in smaller direct-drive sizes.
Page 15 — Item 208

PNEUMATIC CONTROLS .....
for air conditioning by Honeywell includes the Pneumatic Round for the most modern buildings. Company offers a complete line of pneumatic controls, all units being perfectly matched. There are 112 offices across the country for convenient, prompt, efficient service. Information available.
Insert 17-18 — Item 209

VANEAXIAL FAN .....
offered by Buffalo Forge is easily and economically installed because of its rugged, light weight compactness. In all but the largest sizes, no heavy foundation or structural support is needed. Installations are greatly simplified by mounting in straight duct runs. Bulletin available.
Page 19 — Item 210

FULL CONDITIONING LINE .....
is available from American-Standard Industrial Division, which offers one-source responsibility for quality and performance in equipment designed, engineered, and manufactured to work together. Division combines former American Blower, Ross Heat Exchanger, and Kewanee Boiler Divisions. Information available.
Pages 20-21 — Item 211

AIR-LIGHT TROFFER .....
offered by Multi-Vent Division provides both air and light from the same unit. The air diffuser is completely concealed in the flush light fixture. Provides draft-free air conditioning with highly efficient lighting at substantial cost savings. Detailed literature available.
Page 22 — Item 212

COOLING TOWERS .....
from Halstead & Mitchell boast a twenty-year guarantee. Specially treated wood decking resists rotting, fungus attack, and algae which accumulates and obstructs air flow in most other towers. Information is available.
Page 23 — Item 213

COOLING WITH GAS .....
can put a heating plant on a year-round economical basis. Gas operated Arkla-Servel absorption-type water chiller boasts lowest operating costs, fully automatic operation, long service, packaged construction, and easy installation. Information available.
Pages 24-25 — Item 214

HEATING SPECIALTIES .....
by Marsh include uniformly good radiator valves, traps, and vents. Valve is truly packless, its annular mechanical seal keeping it drip tight throughout its long life. Diaphragm of radiator trap is extremely rugged, but very sensitive. Catalog offered.
Page 26 — Item 215

Ad-Digest

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

MONEY-SAVING PUMPS .....
in the Buffalo line include those for clear water, high pressure, heat transfer, chemical liquid, and those of non-clogging design. Broad line means that you pay only for the type, size, and capacity required. Engineered for peak hydraulic efficiency. Information available.
Page 27 Item 216

ROOF-TOP WEATHERMAKER .....
offered by Carrier for flat roof, one story buildings, puts both heating and cooling outdoors. Occupies no valuable floor space. Uses only a minimum of duct work. Permits closer estimates and faster installation. Available in 7.5 and 10-ton capacities. Information is available.
Pages 28-29 Item 217

CAST IRON GAS BOILERS .....
by Weil-McLain deliver both heat and hot water. AGA approved minimum efficiency of 80%. Rated by I-B-R. Compact design. Approved for all gases. Electronic controls part of unit. Sections pass through ordinary door. Complete information available.
Page 30 Item 218

CENTRIFUGAL WATER CHILLER .....
by Chrysler Airtemp is engineered for any air conditioning project from 125 hp to the largest. The economical package cuts operating and service costs with (1) true volute casing, (2) adjustable guide vanes, (3) automatic operation, (4) automatic purger, and (5) interlocked lubrication. Engineering data available.
Page 31 Item 219

BIGGER, BETTER FANS AND BLOWERS
are offered in the Massachusetts line of Peerless Electric. These are the same units that were formerly produced by Bishop & Babcock in Cleveland. Peerless will manufacture the same high quality product. Catalogs available.
Page 32 Item 220

PNEUMATIC CONTROL CENTER .....
serves dual purpose in new H. H. Robertson Co. building. Johnson system supervises dual duct air conditioning equipment and also gives essential performance data for the guidance of Robertson engineers in checking on the operation of their Q-Air floors. Control information available.
Page 33 Item 221

AIR HANDLING, CONDITIONING ....
is handled in modern installation by capillary air washers and power roof ventilators offered by Clarage Fan. Equipment has reputation for faithful performance and operating economy. Bulletins describing units offered.
Page 34 Item 222

VERTICAL TANK SUCTION HEATER ..
for underground fuel oil storage tanks is offered by Davis Engineering. Tank suction heater has easily accessible service connections. The simplest method of preheating fuel oils and other viscous liquids in underground storage tanks. Information available.
Page 35 Item 223

FRICK-STILL INDEPENDENT .....
has been in business since 1853 under the same experienced management, and welcomes the chance to serve both old and new customers. Company wishes to quote on your air conditioning, refrigerating, or ice-making needs.
Page 36 Item 224

DUAL-FUEL BURNER .....
for steel firebox boilers eliminates the need for firebox refractory. Burns fuel completely without need for reflected heat from hot bricks. Called the Power-Blast firing system, it is manufactured by Petro to burn clean in a cold firebox in less than ten seconds. Literature and specifications available.
Page 37 Item 225

TEMPERATURE REGULATORS .....
by Lawler, called Type S, are specified wherever highly accurate thermostatic control is vital. Three models: direct acting, to protect against overheating; reverse acting, for cooling systems and recirculating lines; and three way, for mixing of hot and cold liquids. Information offered.
Page 38 Item 226

AIR DIFFUSION EQUIPMENT .....
is produced by Anemostat in an impressive variety to meet every architectural and engineering requirement. Trademark guarantees quality. Information on complete line available.
Page 39 Item 227

INDUSTRIAL AIR FILTERS .....
from Research Products Corp. explode the fiction that it costs less to buy replaceable filters and throw them away when dirty than to have permanent filters cleaned. Information is available.
Page 40 Item 228

DOUBLY PROTECTED MOTORS .....
offered by Wagner Electric feature rugged cast iron frames and end plates, highly resistant to corrosion. Dripproof enclosures are so well designed that motors can handle many applications formerly requiring splashproof units. Bulletin available.
Page 41 Item 229

HIGH VELOCITY UNITS .....
from Air Devices Inc. provide constant volume under all conditions. Exclusive feature assures precision control of air volume and temperature. Information is available.
Page 42 Item 230

GLASS FIBER PIPE INSULATION .....
manufactured by Gustin-Bacon ensures a maximum return on insulation investment. Comes in one piece and snaps on. High thermal efficiency permits use of thinner wall thicknesses. Retains efficiency indefinitely. Information available.
Page 43 Item 231

UNIT-MOUNTED CONTROLS .....
improve performance of units ventilators. Barber-Colman controls are available for all types of unit ventilators. Design permits economy of factory installation, allows accurate estimates. New application file offered, has specifications and details on control hookups for all leading makes and models.
Page 103 Item 232

OFF-THE-FLOOR WATER COOLER ....
mounts flush with the wall and conceals all plumbing. Only 24 x 15¾ x 13 inches deep, the unit manufactured by Cordley & Hayes has ample room inside for plumbing connections, trap, and shut-off valve. Full information is offered.
Page 104 Item 233

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement. All advertisements are digested here except those that are received too late for inclusion in this listing.

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

AIR DIFFUSION EQUIPMENT .....
from Waterloo Register Co., Inc., is described in new, fully illustrated, color keyed 58-page catalog which is available from the company.
Page 105 Item 234

CENTRAL STATION .....
air conditioning units from Drayer-Hanson are modular constructed and have inside motor mounting. Time saving fan performance curves are offered.
Page 106 Item 235

PORTABLE PYROMETER .....
manufactured by Illinois Testing Labs in a wide selection of thermocouples and extension arms assures adaptation to your needs. Eight scaled ranges are available up to 2000 deg F. Bulletin is available.
Page 108 Item 236

FULL LINE OF HEATERS .....
offering a size and type for every heating need is backed by a highly trained and extensive service organization, with a reputation for dependability and thoroughness. Information is available from Dravo Corp.
Page 109 Item 237

POWER DRAFT UNIT .....
for industrial, residential, and institutional exhausting, is available from Quickdraft. Increases heating and combustion efficiency, provides air power for bulk materials handling, and exhausts corrosive gases and abrasives. No motors, fans or bearings in exhaust lines. Engineering data offered.
Page 110 Item 238

QUIET PUMPS .....
are used in batteries in Home Security Life Insurance Building, Durham, N. C., to circulate hot water for heating and chilled water for air conditioning. Says the plant engineer: "We have complete satisfaction—the pumps couldn't be any quieter." Information available from Bell & Gossett.
Page 111 Item 239

AIR CONDITIONING CONTROL .....
for the Queen Elizabeth Building at the Canadian National Exhibition, the most outstanding building of its kind in the British Commonwealth, has proper thermal environment provided by a Powers quality system. If you are planning a new building inquiries are invited.
Page 113 Item 240

HEATING PUMPS .....
are offered in a complete line by Skidmore Corp. There is a type and capacity for every general or special installation. New vertical pump features close-coupled design and mechanical shaft-seal. Bulletins available.
Page 115 Item 241

HEATING AND VENTILATING .....
units are flexible for any job, versatile for any need. Often one unit will do what normally requires two or more other units. Information is available from McQuay, Inc.
Page 117 Item 242

4-WAY REVERSING VALVES .....
for all reverse cycle systems are made by Alco of cast iron and steel, like a compressor, for long, reliable life. No plastics are used. Independent laboratory tests of 300,000 cycles were without failure to shift and without loss of tight seating. Information is available.
Page 119 Item 243

OS&Y U-BOLT GATE VALVES .....
are made better than need be by Jenkins, but cost less to use. Longer life and reduced maintenance are bound to result from the extra ruggedness, precision, and unique design features. Folder describes Inside Screw and OS&Y patterns.
Page 121 Item 244

CLOG-PROOF SEWAGE PUMPING ....
is better than ever with Chicago Pump's Flush Kleen units with sealed electric floatless pump controller, the only pump controller completely free of becoming insulated or coated with grease or corrosive elements found in sewage and drainage water. Over 13,000 installations. Information available.
Page 122 Item 245

COILS FOR FABRICATING .....
flexible duct connections, vanes for elbows, air scoops, and louvers provide a quick, economical, easy, and practical source of these items. Eliminates most of the work. Shipped in dispenser-type cartons. Information is offered by Cain Mfg. Co.
Page 124 Item 246

SUPPLY PUMPS .....
from Webster Electric are available in capacities to 575 gph. Handle all furnace oils, especially heavy Nos. 5 and 6 grades —with an extra measure of dependability required for commercial and industrial applications. Compact and easy to install. Engineering bulletins with complete specifications and mounting dimensions offered.
Page 125 Item 247

HIGH VELOCITY AIR FILTERS .....
from Air Filter Corp. feature high efficiency, minimum resistance, no direct air passage and large dust holding capacity. Catalogs are available.
Page 125 Item 248

UNDERGROUND PIPE INSULATION ...
is available from Concrete Thermal Casings, Inc. Includes cased thermal concrete for jobs in which water is expected to be over the conduit, Z-crete, for jobs in which water may be over the conduit periodically, and b-t-u, for jobs in which rain or irrigation water may stand over conduit occasionally. Bulletin helps choose system, lists certified contractors.
Page 126 Item 249

ECONOMICAL WATER HEATER .....
made by Bryan Steam is oil or gas fired to meet your requirements, no matter how small or how large. Indirect heat exchanger method provides low cost hot water, economies, and compactness. Catalog available.
Page 127 Item 250

EXPANSION JOINTS .....
from Yarnall-Waring Co. may be serviced in the line under full steam pressure. Costly shutdowns are eliminated. Catalog is available.
Page 128 Item 251

FLEXIBLE HOSE .....
from The Flexaust Co. is adaptable for all kinds of fume and dust control and ventilation uses. It is durable, lightweight, and easy to install. Details are available.
Page 128 Item 252

AIR-COOLED CONDENSER .....
eliminates fans, noise, and maintenance. Edwards Engineering offers a method that for the first time makes possible the elimination of cooling towers. Requires no electrical power. Water is not used, hence there is no water treatment problem. All sizes. Technical data available.
Page 129 Item 253

Ad-Digest

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid multipurpose postcard, either of two that appear on the yellow page following, for further information from manufacturers.

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

FLEXIBLE AIR DUCT .....
from The Wiremold Co. is made with a flat metal spiral that mechanically locks to the fabric component. Two lengths join simply by screwing. Information is available.
Page 130 Item 254

WATER TUBE PACKAGE BOILERS ....
from the International Boiler Works Co. provide more steam — faster and at lower cost. Bulletin is offered.
Page 130 Item 255

AIR FILTER INSTITUTE .....
lists its membership in ad. You can buy air filters with confidence from these members. Information available.
Page 131 Item 256

EASY-TO-INSTALL .....
aluminum roof ventilator is available from Loren Cook Co. Unit is shipped completely assembled, with integral conduit to facilitate wiring. Catalog and booklet, Ideas for Moving Air, are offered.
Page 131 Item 257

CAST IRON RECEIVERS .....
in three sizes now offer a complete line of low pressure system condensate pumps to fit all requirements. Features include low return connection, low speed and long life. Weil Pump Co. bulletin is available.
Page 131 Item 258

COMBINATION BURNERS .....
are available for this company's industrial heaters and are interchangeable with single fuel burners. Lennox "task matched" equipment controls and conditions air for industry. Engineering data are offered.
Page 132 Item 259

LIQUID LEVEL CONTROL .....
made by Magnetrol is the world's most dependable. Because of its utter simplicity, standard model can be easily adapted to meet any special requirement for pressure, temperature, or corrosive liquids. Catalog available.
Page 133 Item 260

DUCT-SEALING TAPE .....
from Arno Adhesive Tapes, Inc., provides the fastest, easiest way to seal ducts and apply insulation. Free sample, information are offered.
Page 133 Item 261

EXTRUDED ALUMINUM SHUTTERS ....
from Elgo Shutter & Mfg. Co. are of modern design, light weight, fully weather-stripped, easier to install, and are rust and corrosion proof. Complete specifications are available.
Page 133 Item 262

SPECIFICATIONS .....
for the cooling and heating coils in the main air conditioning system of the House of Tomorrow Musical Theater in Fort Worth called for top quality and fast delivery. Thermal Engineering delivered both. Information is available.
Page 134 Item 263

SLOT TYPE DIFFUSER .....
called Stripline, combines the best features of both slots and efficient air diffusers to provide equalized air flow throughout its entire length. Slender, inconspicuous, practical and versatile, diffusers can be located in walls, ceilings, coves, moulds, window reveals, and stools. Catalog available.
Page 135 Item 264

STEEL SHEET WON'T FLAKE .....
which fact is proven, as illustrated in ad, by a powerful paving breaker hitting a sample sheet laid on the ground with 75,000 ft-lb of developed energy. Repeated blows hammered the sheet into the ground at the point of contact without a trace of its zinc coat flaking. Information available from Inland Steel.
Page 136 Item 265

VENTILATING BRICKS .....
and blocks in cast aluminum are an ideal air intake for unit air conditioners. According to Construction Specialties, Inc., they are neat, sturdy, economical and efficient. Catalog is offered.
Page 137 Item 266

ROTARY ROOF VENTILATORS .....
from Western Engineering & Mfg. Co. have lifetime guaranteed bearings. High, constant exhaust capacity is assured. Catalog is available.
Page 138 Item 267

GAS AND OIL BURNERS .....
from The Webster Engineering Co. are available large or small, single or dual fuel, packaged or field assembled. Bulletin is offered.
Page 143 Item 268

ADJUSTABLE SPROCKET RIM .....
with chain guide from Babbitt Steam Specialty Co. provides safe operation of overhead valve wheel, and is easy to install and operate. Catalog sheet and prices available.
Page 145 Item 269

ADJUSTABLE ANGLE THERMOMETERS
made by Weksler have freedom of stem positioning, so they will fit into any space. These versatile instruments, supplied in four case sizes, meet every space-saving installation requirement. Information available.
Page 145 Item 270

GAS-FIRED AIR MAKE-UP .....
with units manufactured by Aerovent increases production capacity and improves fan and heating efficiency. Units supply ample quantities of clean, preheated or cool, outside air to replace air exhausted by ventilating systems. Eliminates drafts and negative pressures. Bulletin details sizes and capacities.
Page 146 Item 271

HYDROSTATIC SHOCK CONTROL ....
produced by Jay R. Smith, controls water pressure with pneumatic pressure. Provides a more effective and efficient way to control hydrostatic shock and eliminate water hammer in any hot or cold water piping system. Booklet is available.
Page 146 Item 272

ONLY A FEW .....
seconds' time is required to insert cartridges in the efficient and high capacity multiple cartridge filter-drier manufactured by Henry Valve Co. Information is offered.
Inside Back Cover Item 273

HOT WATER BOILER PROTECTION ...
is offered by McDonnell & Miller. The What-Why-How of water level control of hot water space heating boilers is discussed in eight interesting pages of their new bulletin. Low water cut-off or, for even greater precaution, a feeder cut-off combination are discussed.
Back Cover Item 274

CIRCLE FOR NEW EQUIPMENT AND LITERATURE INQUIRIES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110

CIRCLE FOR AD-DIGEST INQUIRIES

200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265
266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309

PLEASE PRINT CLEARLY

Name .....

Title or Job Function .....

Firm .....

Nature of Firm's Business .....

Street .....

City .....Zone ....State .....

TO ORDER BOOKS DESCRIBED BELOW

Please send and bill me for the books circled: July '59

A B C D E F G H I J K L M N O P Q R S T U V

FIRST CLASS
PERMIT NO. 53
NEW YORK, N. Y.

BUSINESS REPLY MAIL
NO POSTAGE NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

AIR CONDITIONING, HEATING and VENTILATING
93 WORTH STREET
NEW YORK 13, N.Y.

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67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
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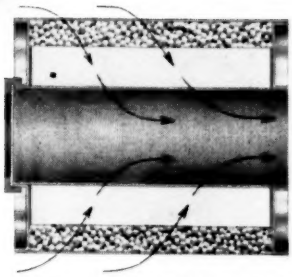

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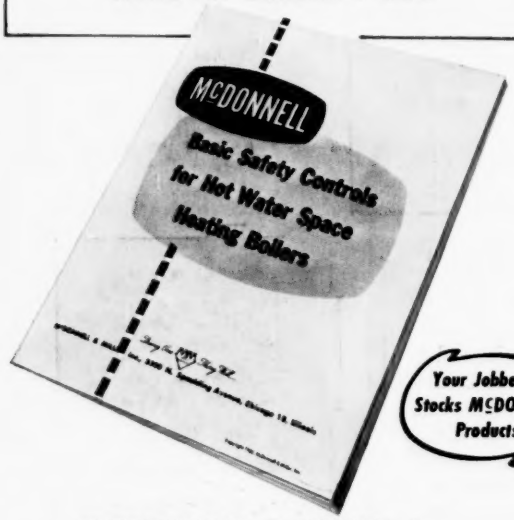

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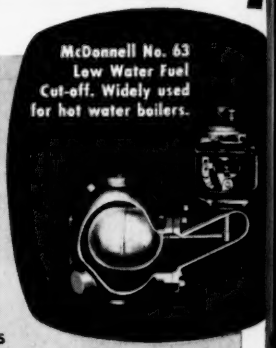

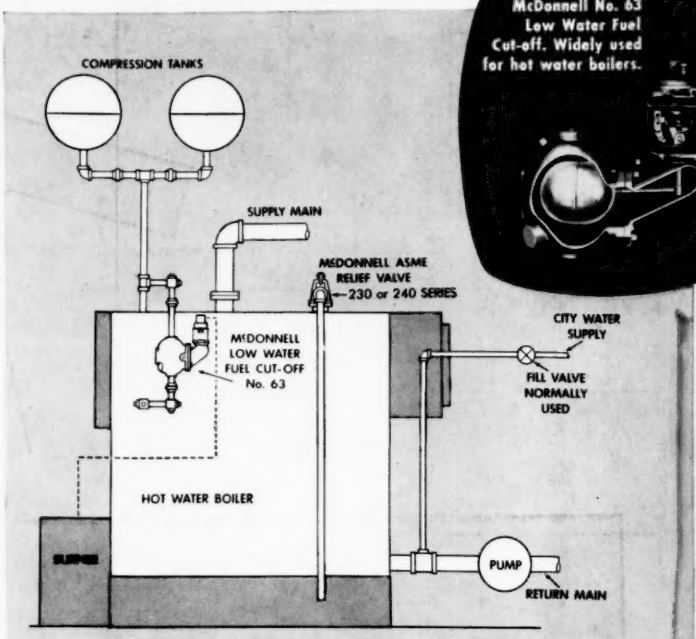

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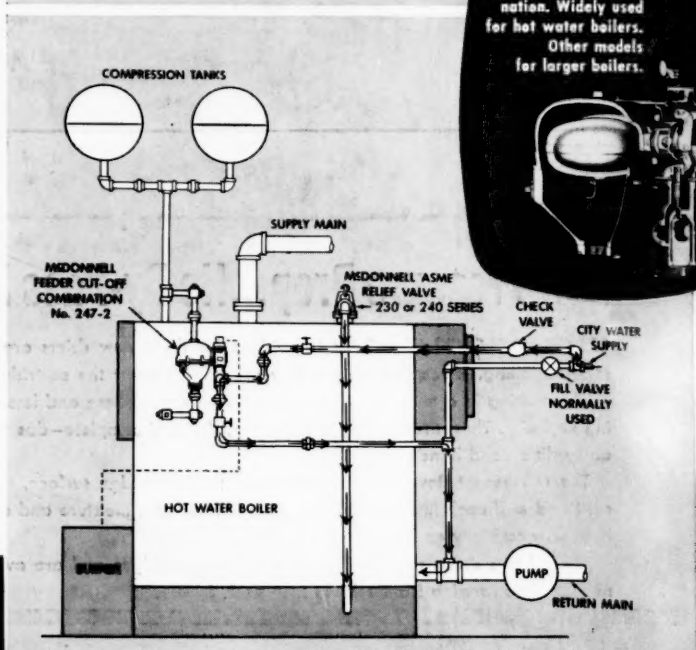

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